The Electrical Industry's Weekly Magazine June 6, 1960

Electrical World

Price 50 Cents

A McGraw-Hill Publication

California Sierras Make Temporary Line Construction Tough...

...page 52

Con Ed Installs Reactor Vessel at Indian Point A-Plant... p 44

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ALLIS-CHALMERS

"Originators of 5/8% Step Regulators"

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More new JFR advantages! Now offered as *standard*, position indicator drag hands reset by pushbutton on the control panel. A new, quick-sight gauge instantly reveals oil level. Exclusive unidirectional breather removes all moisture and contaminating gases. And a new cover, with hidden bushing mounting studs, cuts maintenance. *For all the facts ask your nearby A-C office for new JFR Bulletin 21B7977E or write* **Allis-Chalmers,** *Power Equipment Division, Milwaukee 1, Wisconsin.* A-1261

Electrical World

Vol. 153, No. 23 JUNE 6, 1960

Published for 86 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

In This Week's Issue

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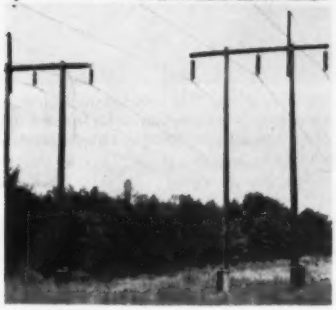

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Makes Toil of Temporary Line

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Reconductoring Merits Bigger Construction Role

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AFTER 30 YEARS ON THE JOB . . . Okolite insulation still looks good. This unretouched photograph shows a section of 11.5 Kv power cable recently re-assigned by Duquesne Light Company. Note that the insulation is still flexible and resilient—workable. Tests made this year show the tensile strength has deteriorated very little, remaining more than 33% above the original specification figure.

30-year-old Okonite cable still tests above specification figures . . .

This is CABLE'BILITY *a new word for your vocabulary*

Cable'bility (cā'ble·bil'·i·ty) *new word. Noun.* **1.** Ability to design and manufacture electrical cables that give outstanding performance. **2.** Having long background and wide experience in cable research and application. **3.** Possessing keen understanding of customers' problems. Implies eagerness to serve faithfully and dedication to progress. **Syn.** The Okonite Company.

This is Okonite Cable'bility at work. It's "Old Faithful"—a 1250 MCM, Okolite-insulated power cable made in 1929, now carrying on a new career as a mine power feeder for Duquesne Light of Pittsburgh.

"Old Faithful" began service as an 11.5 Kv lead from switchyard to transformer, handling 15,000 KVA loads. During World War II, it saw fifteen years of full load operation, 24 hours a day. Then in 1957 it was replaced with a larger cable to handle even greater loads. But it was found still suitable for demanding tasks as a power feeder.

There are Okonite "Old Faithfuls" in use today in every application . . . *yours* too. Because, as in 1929, Okonite still produces the most dependable cables on the market. The reason is Cable'bility. The Okonite Company, Subsidiary of Kennecott Copper Corporation, Passaic, N. J.

***where there's electrical power . . . there's* OKONITE CABLE**

6960-A

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LETTERS

Why Call It "Demand?"

To the Editor:

You had some interesting comments in your March 28 issue under the heading "Editorial Comment," regarding problems with the word "demand." As is often the case, we lack a precise word to fit the situation and attempt to use some existing word which then never quite fits and is always bothersome to many people. Of the several words suggested it seems to me that "demand" is closer to being descriptive than other words suggested, but I am wondering why the industry doesn't create a new word for this requirement.

Any time that we use an old word it tends to carry different connotations to different people, whereas a new word could have its own definition and hence a more uniform meaning. For example, what about a word that is a combination of demand and watt or kilowatt, such as a word "dewatt."

With the several aggressive electrical and utility organizations which we have in this country and the general cooperation extended by the numerous utilities and electrical manufacturers, it would seem to me that if some official body such as the AIEE and or the Prime Movers could agree on a new word, it would find acceptance in the industry and be in common usage in a very short time.

Our language would be more interesting and useful if we used newly created words for precise meanings. I suggest creating and using an entirely new word as a desirable solution to the problem of finding a substitute for the word "demand."

Perhaps you can carry on from there.

C. K. Lewis
Bechtel Corp
San Francisco, Calif.

Music From Light Bulbs

To the Reader:

We couldn't help but notice in the Illinois Power Co house organ a few months back the story of the college fellow who has made a musical instrument from light bulbs. He calls it the Mazda Marimba.

The bulbs of all sizes have had bases removed and are placed on a tripod. The sound is produced by tapping lightly on the bulbs. It must be amplified electronically to be heard in an orchestra.

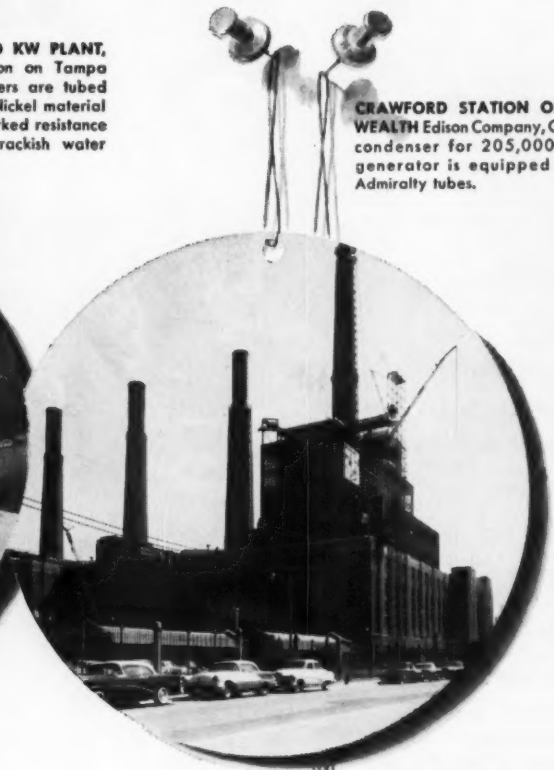
Could be an idea for a hobby.

The Editors

This column is your forum in Electrical World. We invite your comments, suggestions, criticism. Correspondence should be addressed to "Letters Editor," Electrical World, 330 W 42nd St, New York 36, N. Y.

TUBED BY REVERE MEANS TUBED TO LAST

A. W. HIGGINS 135,000 KW PLANT, Florida Power Corporation on Tampa Bay. Here all 3 condensers are tubed with Revere 10% Cupro-Nickel material because of this alloy's marked resistance to corrosion from the brackish water encountered.



CRAWFORD STATION OF COMMONWEALTH Edison Company, Chicago, where condenser for 205,000 kw. turbine generator is equipped with Revere Admiralty tubes.

A few more power companies who depend on REVERE Tubes for performance plus service

Revere's Technical Advisory Service, because of its long and varied experience, is qualified to help in the selection of the alloy best suited to the specific set of operating conditions encountered in *your* power plant. This experience, which has covered many and varied types of problems, has been instrumental in prolonging tube life for power plants both large and small.

Why not take advantage of this storehouse of knowledge and contact Revere before making the final selection of tubes and plates for your equipment?

REVERE COPPER AND BRASS INCORPORATED

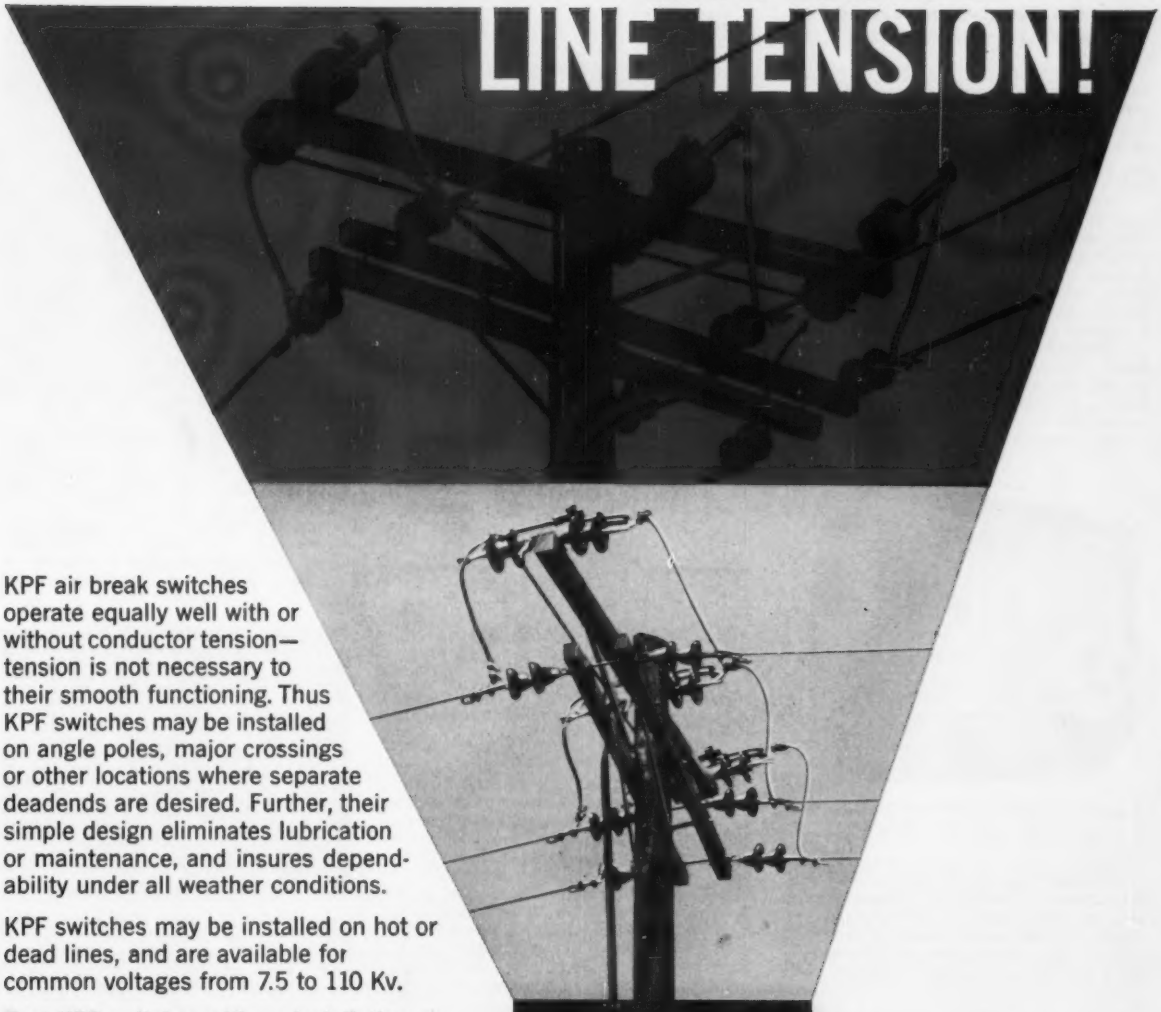
Founded by Paul Revere in 1801

230 Park Avenue
New York 17, N. Y.

Mills: Rome, N. Y.; Baltimore, Md.; Chicago, Clinton and Joliet, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Brooklyn, N. Y.; Newport, Ark.; Ft. Calhoun, Neb. Sales Offices in Principal Cities, Distributors Everywhere.

ALLIS-CHALMERS CONDENSER serving the new 265,000 kw. turbine generator Unit #2 River Rouge Station, Detroit Edison Company contains 249,000 lbs. of Revere Admiralty condenser tubes. Tube sheets are Revere Muntz Metal. A lasting combination!

INSTALL KPF SWITCHES WITH OR WITHOUT LINE TENSION!



KPF air break switches operate equally well with or without conductor tension—tension is not necessary to their smooth functioning. Thus KPF switches may be installed on angle poles, major crossings or other locations where separate deadends are desired. Further, their simple design eliminates lubrication or maintenance, and insures dependability under all weather conditions.

KPF switches may be installed on hot or dead lines, and are available for common voltages from 7.5 to 110 Kv.

Test KPF switches with an installation on your own system. Inquire now!

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AIR BREAK SWITCHES
Standard for half a century

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TRIPLE LANE TUBE LAYOUT . . . what it is and how it IMPROVES CONDENSER OPERATING EFFICIENCY

An informative advertisement from one of the nation's most experienced condenser manufacturers

Steam condenser efficiency depends on water temperature and condition, proper maintenance procedures and many other factors. One of the most important is the design of the condenser itself—and *this* is largely a function of tube sheet design.

Triple Lane Tube Layout, a development of C.H. Wheeler Manufacturing Company of Philadelphia, is making significant contributions to condenser operating efficiencies in public utilities and industrial plants throughout the country. Figure 1 shows a C.H. Wheeler Dual Bank Surface Condenser with Triple Lane Tube Layout.

This tube sheet design permits steam to travel through three separate pathways. As a consequence steam penetrates to all condensing surfaces and utilizes to the fullest extent the condensing capabilities of the steam condenser.

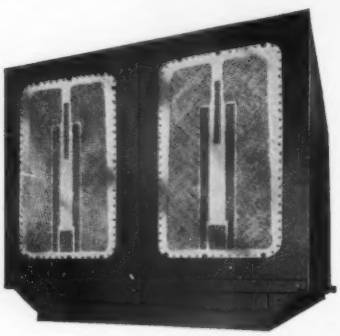


Figure 1: Typical C.H. Wheeler Condenser with Triple Lane Tube Layout.

Central location of the air cooler section, another C.H. Wheeler design feature, also improves steam travel. It reduces the depth of steam penetration and therefore reduces resistance to steam passage, achieving a new low in condenser pressure loss.

How Reverse Flow Improves Condenser Efficiency, Reduces Maintenance

Proper maintenance—keeping tubes and tube sheets free from foreign matter, algae and scale—helps keep condensers operating at peak efficiency. In some cases grass and twigs build up to a point where they would ordinarily have to be shoveled out! It is in such cases that C.H. Wheeler Reverse Flow solves time-consuming, expensive maintenance problems. Here's how it works:

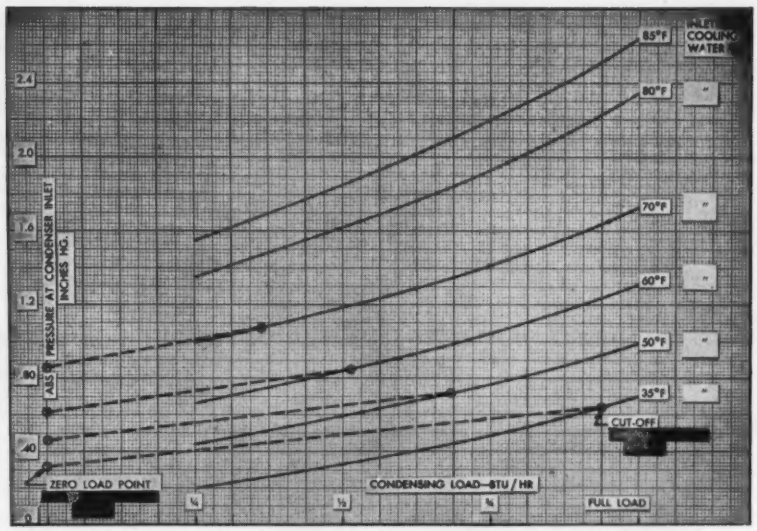


Figure 2: Typical condenser performance curves show how inlet cooling water temperature affects absolute pressure at condenser inlet at varying condensing loads. For a complimentary copy of the 38-page Condenser Handbook from which these curves are taken, write to C.H. Wheeler on your company letterhead.

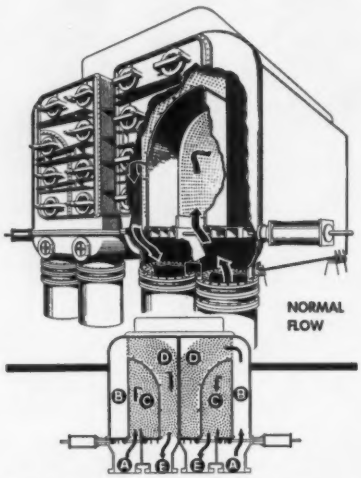


Figure 3: Diagram of C.H. Wheeler Reverse Flow which cleans tubes and sheets during full load operation.

Normal operation is shown on the left in the diagram in Figure 3. Water enters through inlet A with inside port open, flows through tube bank C to the rear of the condenser. It returns through tube bank D to the front of the condenser and discharges at E.

The right side of the diagram in Figure 3 shows Reverse Flow in operation in a C.H. Wheeler Dual Bank, Divided Water Box Condenser. Water enters through A with outside port open, flows up through channel B and through tube bank D to rear of condenser, returns through tube bank C to front of condenser and discharges at E.

Reversing can be accomplished during full load operation and full flow of circulating water, without additional pressure loss. Sluice gates for each half of the condenser move on a common stem. Each half of the condenser can be back-flushed independently; or both halves can be back-flushed simultaneously with one or two circulating pumps operating.

Because of more-than-half-a-century of experience in condenser design and maintenance, C.H. Wheeler is unusually well qualified to advise on condenser efficiency and maintenance problems. We invite your inquiry, whether you're concerned with condensers or with circulating and condensate pumps and other auxiliary equipment. A note on your company letterhead will receive prompt attention from us.

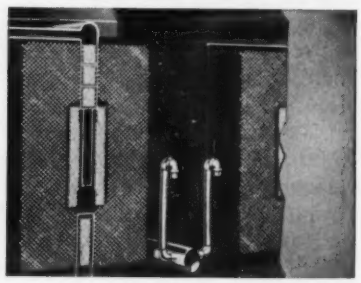


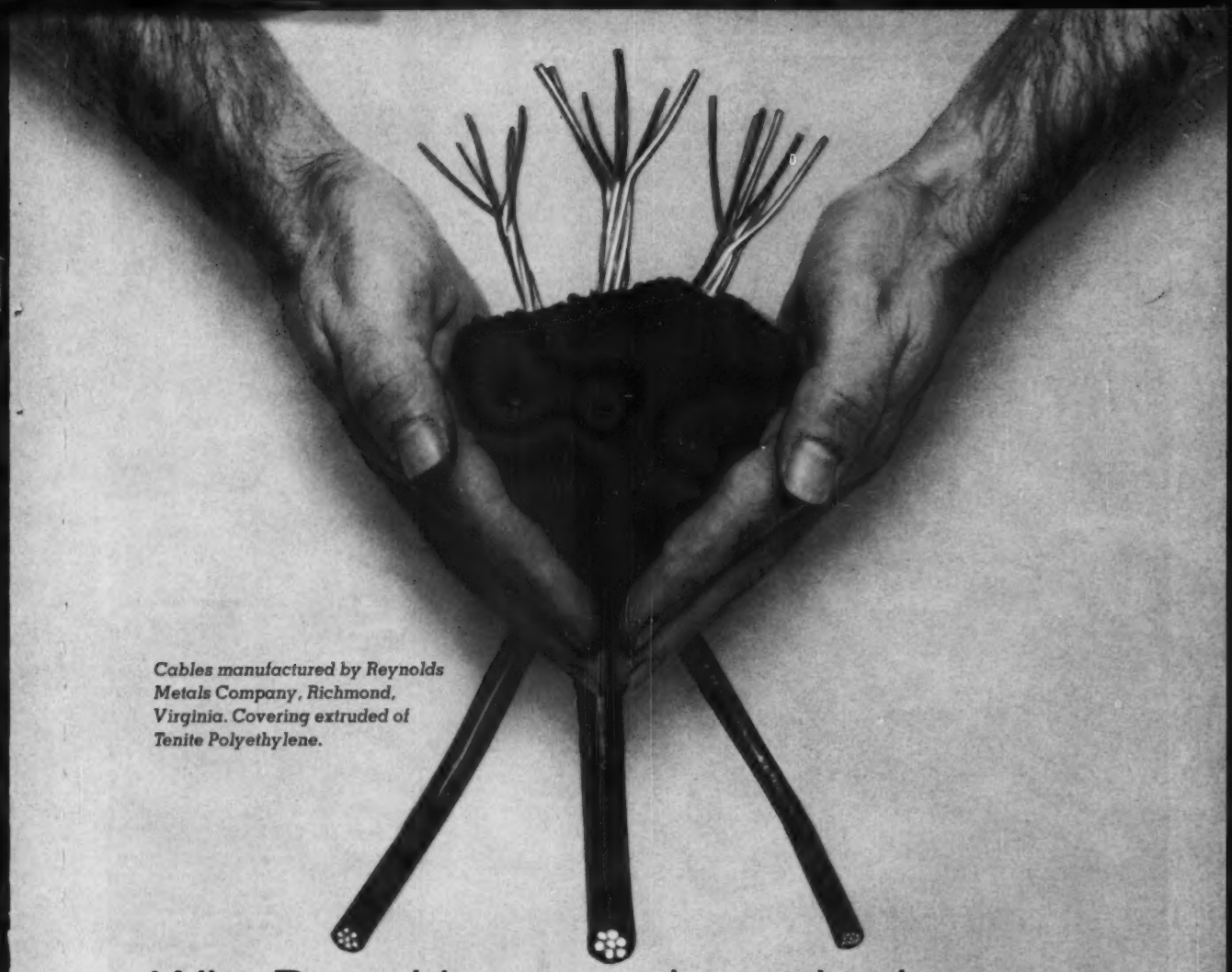
Figure 4: Central location of air cooler section in C.H. Wheeler Condensers reduces depth of steam penetration and therefore lessens resistance to steam passage, achieving a new low in pressure loss in the condenser.

C. H. WHEELER MFG. CO.

19th and Lehigh Avenue • Philadelphia 32, Pennsylvania

Whenever you see the name C.H. Wheeler on a product, you know it's a quality product.

Steam Condensers • Steam Jet Vacuum Equipment • Centrifugal, Axial and Mixed Flow Pumps • Marine Auxiliary Machinery • Nuclear Components



Cables manufactured by Reynolds Metals Company, Richmond, Virginia. Covering extruded of Tenite Polyethylene.

Why Reynolds covers these aluminum conductors with TENITE POLYETHYLENE

To obtain the highest possible performance from their secondary distribution and service line cables, Reynolds Metals Company chooses Tenite Polyethylene as a covering material.

Tenite Polyethylene is manufactured under as rigid a system of quality control as Reynolds' own aluminum conductors, and makes a tough, weatherproof, fast-stripping covering material which offers high dielectric strength and resistance to abrasion, heat, moisture, chemical attack and stress cracking. It remains flexible even at sub-zero temperatures and its light weight permits easy handling and wide spans. Users report that it gives long service life without festooning or splitting.

Tenite Polyethylene is easily extruded as jacketing or insulation for many diverse applications, from coaxials to control cables, from TV lead-ins to telephone wires. For a material with outstanding electrical, physical and chemical properties, specify Tenite Polyethylene. For further information, write EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENNESSEE.

Both natural and black electrical grade Tenite Polyethylene are available to cable manufacturers in a unique spherical pellet form which flows freely in the extrusion process and in "air-veying" of bulk shipments from truck to bin.

TENITE®
POLYETHYLENE
an Eastman plastic

PROOF THAT CHEVY'S BIG NEW CABS ARE BUILT FOR A BETTER DAY'S WORK!

"THESE TRAILS WOULD SHAKE THE CAB OFF AN ORDINARY TRUCK...BUT NOT OUR CHEVY"

Few trucks are subjected to the body-wracking beatings that are part of a day's work for this Chevrolet Series 60 pulpwood hauler, owned by J. E. Fox, North Carolina logging contractor. As Bobby Fox, a partner in the business points out, "Loaded full-up with pulpwood, we drive right over stumps and potholes you'd think would tear the truck to pieces. These trails would shake the cab off an ordinary truck, but not our Chevy. Chevies are built to hold together longer."

■ No matter where you haul, you'll profit by the new toughness that's built into Chevrolet truck cabs for '60. You'll benefit from a cab that stands up to slam-bang runs over rough terrain, a cab that stays in A-1 shape years longer. Here are some of the ways in which Chevy assures this tight, maintenance-minimizing performance:

1. Tough new longitudinal sills reinforce the underbody; provide a solid foundation for cab sheet metal.

2. Extra-sturdy door openings—box-section pillars and sills assure lasting alignment. Doors stay weathertight with a minimum of maintenance.

3. New double-walled roof makes cab stronger and safer. Box-section pillars provide solid roof support.

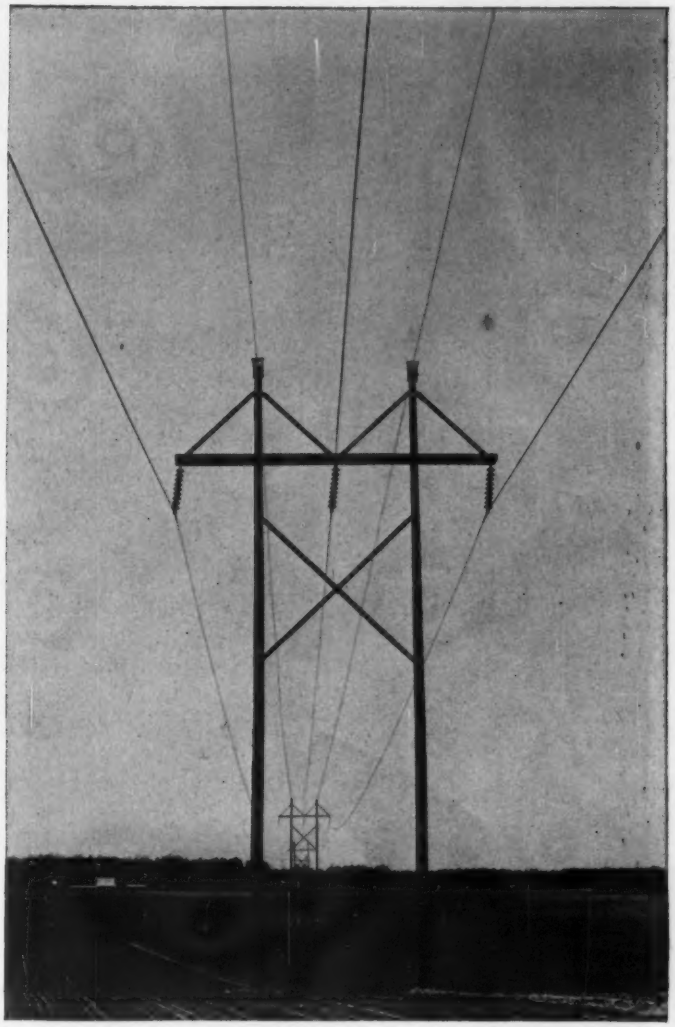
There's a world of comfort for you, too. A wide seat, for instance, that softens the ride yet gives you extra support where it's needed. And there's more head room, hip room, shoulder room and leg room for rangy drivers.

First chance you get, visit your dealer and drive a new Chevy. Experience new Torsion-Spring Ride. Check up on Chevy's famous gas-saving 6's and V8's. Then you'll know, for sure, why you can expect thousands of extra miles out of a Chevy; why you can be sure of more work per day at least expense. . . . Chevrolet Division of General Motors, Detroit 2, Michigan.

1960 CHEVROLET STURDI-BILT TRUCKS

CHEVROLET

Bethanized Strand protects 54-mile power line



The conductors of this 54-mile, 138 kv line, which is owned by The Eastern Shore Public Service Company of Maryland, are protected by two overhead ground wires of ⅜-in. ASTM A-363 7-wire Bethanized "C" coated strand. The line, on the Delmarva Peninsula, originates near Millington, Md., and terminates at Vienna.

You can obtain just about any degree of protection against corrosion when you use bethanized strand. In the "A" weight, bethanized coatings are adequate for normal atmospheric conditions. They are also furnished in "B", "C" and "D" weights for added protection against corrosion in industrial and marine atmospheres.

The "D" coating, furnished in common, Siemens-Martin and high-strength grades, contains four times the weight of the "A" coating. The "C" coating is three times the weight of "A"; the "B" coating is twice the weight of "A". Each coating is 99.9 per cent pure zinc, and is applied by our unique electrolytic process which insures uniformity.

For full information on bethanized strand, get in touch with the nearest Bethlehem sales office.

Steel

for Strength
... Economy
... Versatility

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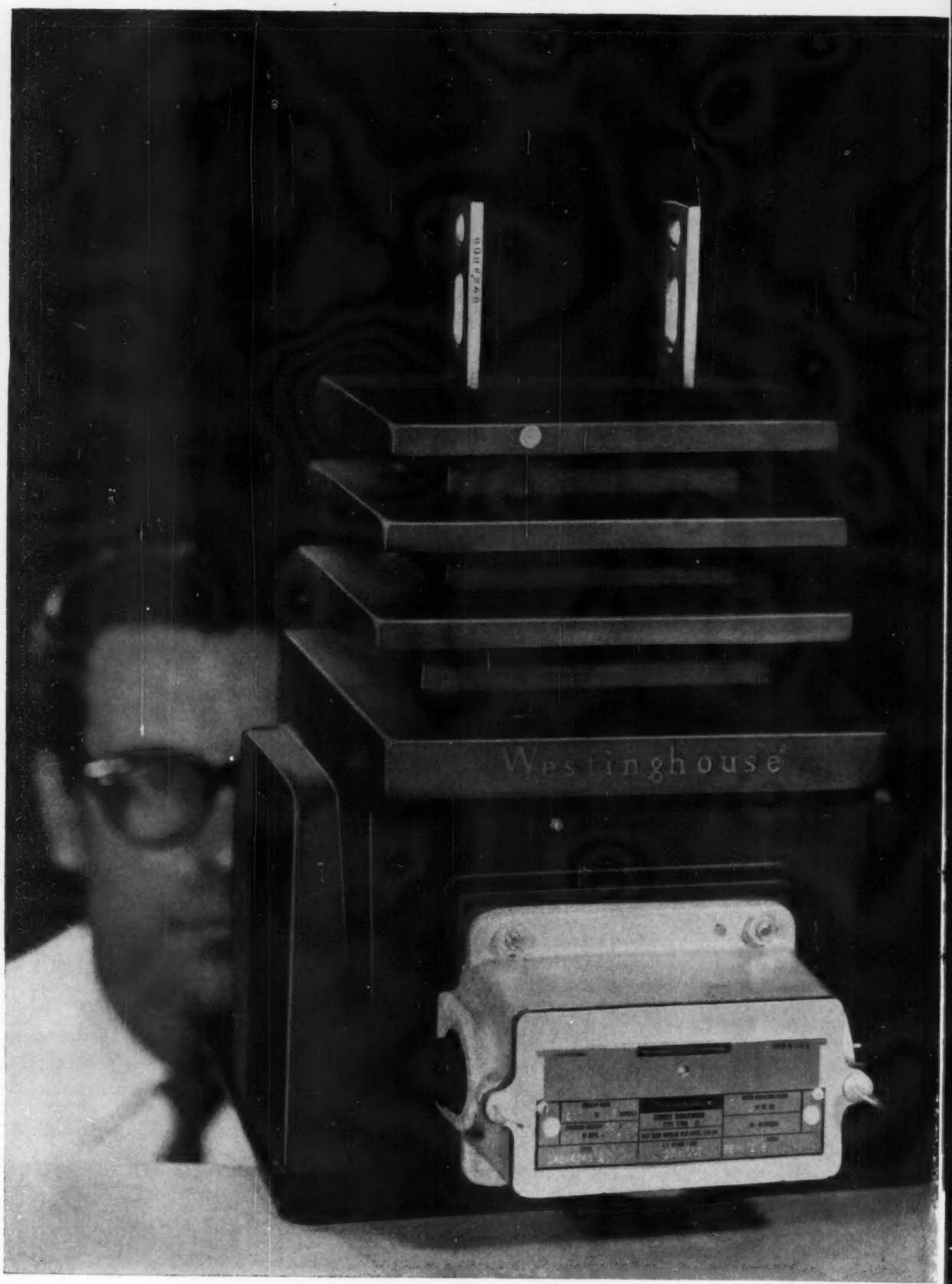

Westinghouse

NEW WESTINGHOUSE 15-KV MOLDED CURRENT TRANSFORMER WITH REMOVABLE CONDUIT BOX

. . . far easier to hang and change out
. . . virtually maintenance-free

The Type CTOM-15, molded of HV Rubber, offers you these concrete advantages over its predecessors and present equivalent designs!

REMOVABLE "HAND-SIZED" CONDUIT BOX

- Allows changeouts without disturbing present conduit connections.
- "Hand-sized" conduit box provides 150% more working area.

HIGHER RATING FACTOR

- 50% higher than previous designs—1.5 all the way through 600 amperes. This means more overload capacity for you.

HV RUBBER CUTS MAINTENANCE

- Eliminates broken bushings and need for painting.
- Reduces corrosion problems and damage due to rough handling.

20% LIGHTER AND 38% SMALLER

- Molded construction makes possible CTOM design which is easier to handle and install —plus improved transformer performance characteristics.

QUICK AND POSITIVE IDENTIFICATION

- Westinghouse ratio decals make the CTOM easy to identify—either on the pole or in the warehouse.

LONGER OPERATING LIFE

- HV Rubber—forms a rugged, yet flexible transformer housing. It is chemically inert, impervious to industrial contamination, severe temperature cycling and salt spray.

MOUNTS EASILY IN ANY POSITION

- Allows for bottom, top or side connections.

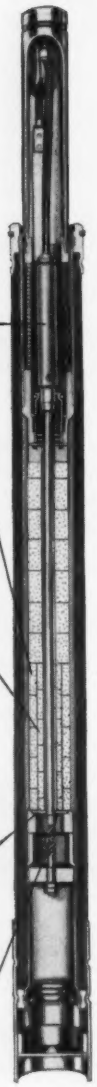
J-70943

YOU CAN BE SURE...IF IT'S

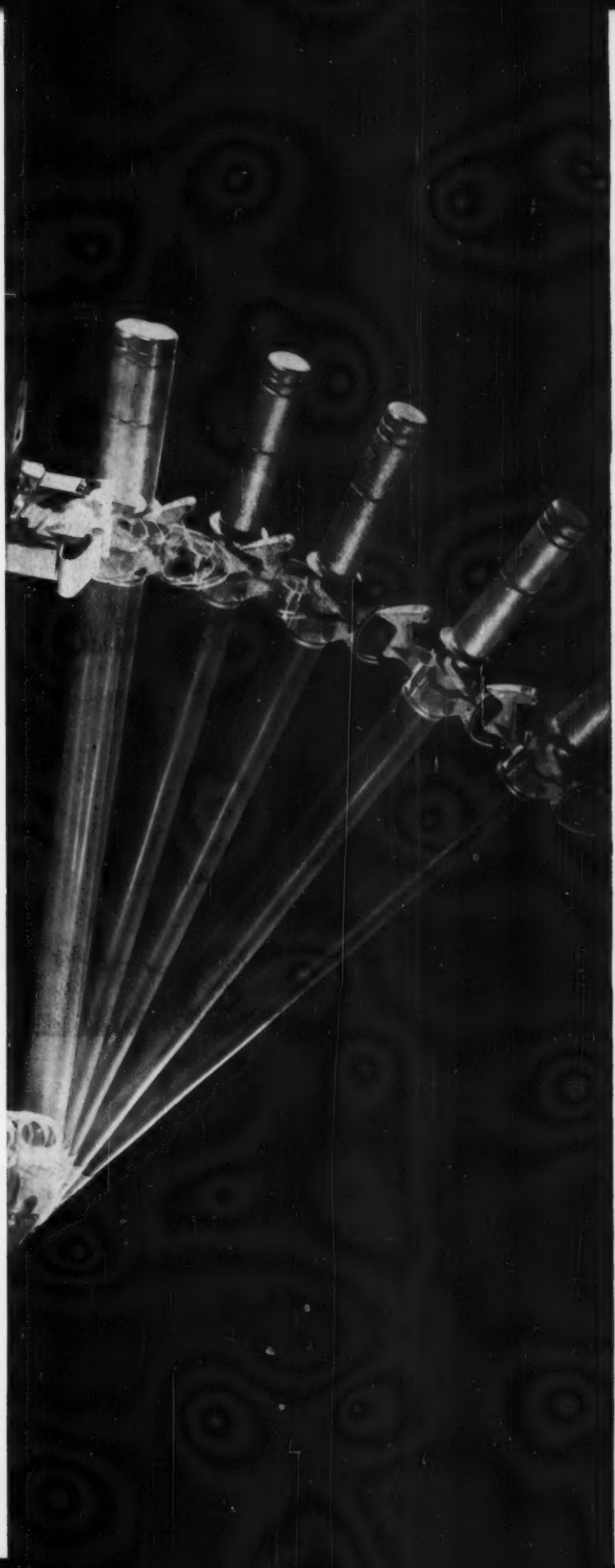
Westinghouse

TUNE IN WESTINGHOUSE-CBS TV-RADIO COVERAGE, PRESIDENTIAL CONVENTIONS, JULY 10-29

NOW 2,000,000 kva


CO_2 gas bomb—insures arc extinction on lowest faults
Fixed boric acid cakes—cemented to inner fibre liner—provide large bore for high faults
Expellable boric acid cakes provide minimum diameter bore for effective interruption of medium-to-low faults
Frangible retaining disc supports expellable boric acid cakes. The blast action of high faults ruptures the disc and expels the inner cakes. The resultant larger bore reduces internal pressures and exhaust gas velocities
Fusible element—nondamageable construction

SMD—2B FUSE UNIT



100% higher interrupting ratings for S&C Power Fuses... and confirmed by test

This new performance level means you can now use power fuses on power transformers tapped onto transmission and subtransmission lines—even where faults may run as high as 2,000,000 kva. Now you can have power fuse protection of small-to-medium transformers in even more places on your system. You have more opportunities to get the benefits of S&C Power Fuses: low-cost, maintenance-free protection against primary and secondary faults, without momentary interruptions on the line.

All this is made possible by S&C's new SMD-2B Power Fuse, which uses a new principle in boric acid circuit interruption, explained on the opposite page.

Behind these new ratings* is a three-year program of laboratory and field testing, culminating in the heaviest faults ever deliberately applied to a power fuse. At the KEMA laboratories at Arnhem, the Netherlands, a power fuse (S&C's SMD-2B) for the first time successfully and repeatedly cleared line-to-line faults of 2,000,000 kva magnitude.

For complete information, write for Descriptive Bulletin 261.

*New ratings established by test

Voltage Rating, Kv	Interrupting Rating, Kva New	3-Phase Symmetrical Old
34.5	1,500,000	1,250,000
46	1,750,000	1,250,000
69	2,000,000	1,500,000
115	2,000,000	1,000,000
138	2,000,000	1,000,000

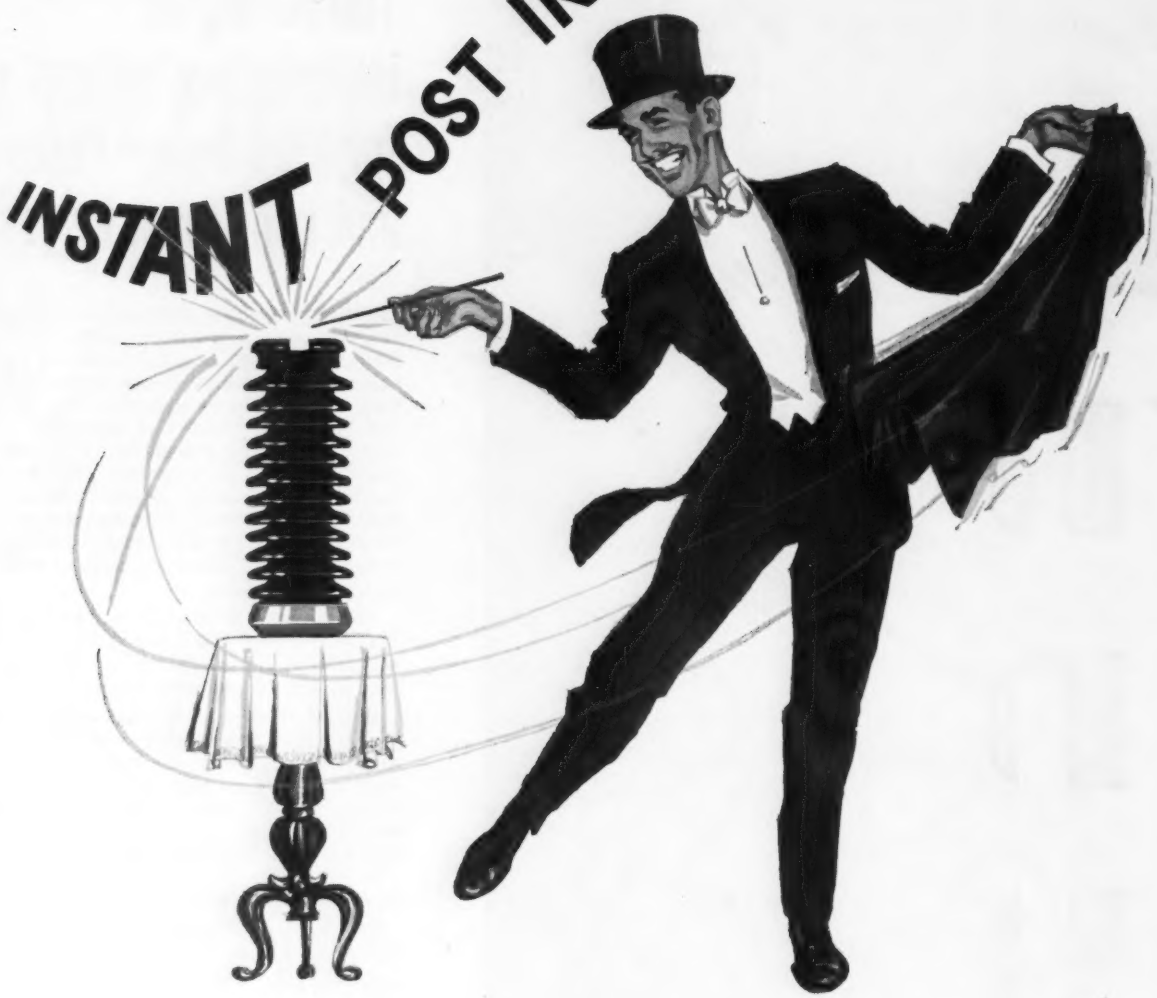
S & C ELECTRIC COMPANY

4421 Ravenswood Avenue • Chicago 40, Illinois

Specialists in High Voltage Circuit Interruption since 1911

S&C

INSTANT POST INSULATORS ?



Not yet. Lots more to it than "Let's get into the Line Post and Station Post business." Yet as more and more power companies standardize on Lapp's better insulator design, more and more imitations crop up.

Pretty good copies, some of them—in looks. Funny thing, though, you don't see many around. Partly because they couldn't copy the most important thing: Lapp's 30 years of taking out the bugs, putting in the failure-free performance characteristics.

Your only reasons for specifying Line Posts and Station Posts on your systems are for fewer interruptions of service, lower maintenance and replacement costs. Makes sense to get them from the company that pioneered, proved and perfected them.

Lapp

New Lapp Catalog Eight tells lots about Line Posts and Station Posts. Write for your copy.
Lapp Insulator Co., Inc., Le Roy, New York.

Need Copperweld Ground Rods or Clamps in a hurry? Just contact any of the following Pole Line Hardware Manufacturers or their Jobbers—located from coast to coast. They have large stocks available for quick delivery to you.

A. B. CHANCE COMPANY
210 N. Allen St., Centralia, Mo.

HUBBARD AND COMPANY
200 S. Michigan Ave., Chicago 4, Ill.

JOSLYN MFG. AND SUPPLY COMPANY
155 Wacker Dr., Chicago 6, Ill.

LINE MATERIAL INDUSTRIES
700 W. Michigan St., Milwaukee 1, Wis.

OLIVER ELECTRICAL MFG. COMPANY
170 Angell St., Battle Creek, Mich.

Millions of Copperweld Ground Rods—the only molten-welded rods—are in use protecting billions of dollars worth of equipment.

COPPERWELD STEEL COMPANY
WIRE AND CABLE DIVISION *Glassport, Pa.*
For Export: COPPERWELD STEEL INTERNATIONAL COMPANY, N.Y.

Another Engineering Achievement

FEDERAL PACIFIC FUSEMATIC

A NEW CONCEPT IN RELIABLE LOW COST CIRCUIT PROTECTION

Now 200,000 amp interrupting capacity breaker at low cost! Fusematic combines a low voltage power circuit breaker with coordinated current limiting fuses in an integral unit. This combination gives you a 600 volt, 1600 ampere breaker with 200,000 amp interrupting capacity. Lower fault current and faster interruption mean improved short circuit protection plus reduced maintenance expenses at substantially lower initial cost.

SAFE. Can close against faults up to 200,000 a.

ECONOMICAL. Current limiting fuses reduce possible fault current permitting use of smaller frame size circuit breakers.

COMPACT. Only 24" wide by 22½" high. Units stack four high in 90" enclosure.

VERSATILE. Available in manual or electrical operation, fixed or drawout mountings for both indoor or outdoor construction.

PROVIDES SINGLE PHASE PROTECTION.

Get the full details of FUSEMATIC features and economies. Write for Bulletin 6020, Federal Pacific Electric Company, General Offices: Dept. 409, Newark 1, New Jersey—The Best in Electrical Control, Distribution and Power Equipment. *Trademark

FPE

FEDERAL PACIFIC ELECTRIC COMPANY

Affiliated with Cornell-Dubilier Electric Corporation

The Electrical Week

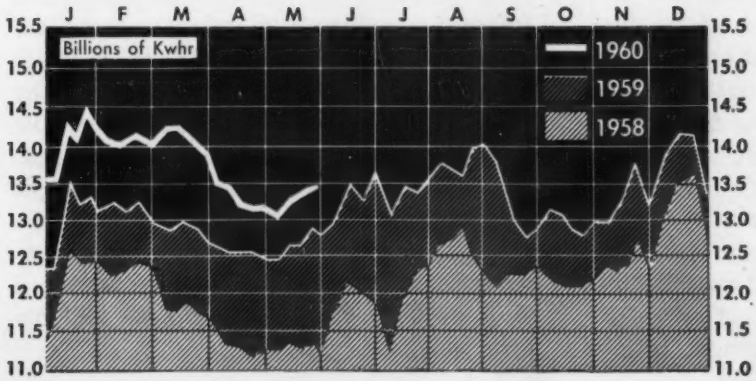
LATE NEWS ▶ **Washington Wire** . . . House Interior Subcommittee holds another executive session June 9 on Burns Creek project . . . Same group will have two-day hearing, starting June 6, on Fryingpan-Arkansas $170-million hydro power and irrigation project . . . Joint development of Columbia River will be discussed by US-Canadian delegation June 20 at Ottawa . . . House vote on "downstream benefits" or "headwater benefits" bill (HR-7201) is expected this month. Bill is intended to correct "one way street" that does not require downstream federal reservoirs to reimburse upstream non-federal dams for water or power benefits, although it is a requirement imposed on non-federal installations.

UE workers go back to their jobs at Westinghouse Steam Division after a 15-day strike.

Around the States . . . Puget Sound P&L signs agreement with Douglas County (Wash.) PUD to finance preliminary engineering on Wells Dam on the Columbia River. Puget Power is to get 35% of power from PUD project in return for financial participation . . . Merger of International Talc Co and Oswegatchie L&P, New York, not approved by the state's attorney general . . . Package agreement is reached between Memphis LG&W with TVA settling law suit brought by city on terms of power contract. TVA will supply city with power needs anticipated in 1962, '63 summer peaks. Memphis customers will get more than $900,000 in refunds—city will delay adding generator . . . Dayton P&L is only bidder on Greenfield, Ohio, municipal plant and system. Bid is for $1,125,241.

Management changes . . . P. O. Canaday elected president, Arkansas P&L . . . New president of McGraw-Edison Co is Alfred Bersted . . . E. H. Stonecipher elected president, Arvin Industries.

WEEKLY POWER OUTPUT—UP 6.2% (Week ending May 28), Kwhr 13,572,000,000



Per Cent Change From Previous Year

	May 14	May 21	May 28
Total U. S.....	+ 5.3	+ 4.2	+ 6.2
New Eng.	+ 7.9	+ 3.6	+ 8.0
Mid. Atlan.....	+ 4.9	+ 3.2	+ 4.5
Cent. Ind.	+ 4.9	+ 0.9	+ 3.3
West Cent.....	+ 5.4	+ 3.7	+ 7.8
Southeast	+ 5.9	+ 5.1	+ 5.9
South Cent.	− 1.1	+ 4.5	+ 4.5
Rocky Mount...	+ 7.5	+ 7.9	+10.5
Pacific			
NW	+ 7.8	+10.6	+18.6
SW	+ 7.7	+ 7.5	+ 8.8

Seasonally Adjusted Index 267.1

Week Ago 271.4 Year Ago 254.7

Source: Edison Electric Institute

Preview of This Issue

EVENTS ▶ **A "Code of Ethics" for regulatory commissions may result** from the recent Federal Power Commission hearings. In a separate but concurrent development, election-year politics is coming into the picture: a Senate drive to keep Connole on FPC is a possibility (p 40) . . . Bureau of Reclamation wants a revolving fund for certain expenditures (p 41) . . . Pennsylvania PUC will probe earnings of seven companies (p 42) . . . Tidal wave knocks out 70% of Hilo Electric's capacity (p 43).

ENGINEERING ▶ **Providing temporary service can be a man-sized job** when that service is to a construction site. Southern California Edison found this out when it undertook the Mammoth Pool hydro project in the High Sierras. The difficulties are described in this week's cover story, **page 52** . . . Some of the latest thinking about lightning protection of unit-connected generators encompasses arrestor characteristics, generator insulation and protection requirements. A simple, accurate, straightforward method for determining protective requirements begins on **page 46** . . . Reconductoring saves time, money and effort, Virginia Electric & Power finds (p 50) . . . The 13.8-kv "get-away" circuit from AEC's gas-cooled reactor generating plant in Oak Ridge, Tenn., has unusually high capacity (p 54).

Politics and Public Power

ON THE BOARDWALK IN ATLANTIC CITY

There is a touch of irony in the fact that barely 100 miles south of Thomas Edison's Menlo Park laboratory about 2,000 leaders of the great American industry his inventions made possible will gather to face the problems that plague that industry's well being and survival.

They will come together at the 28th annual convention of Edison Electric Institute in Atlantic City, N. J. And they will bring with them a set of problems that contrast sharply with the beach-cart nonchalance of that city's famous boardwalk.

What these people say, what they do there on the edge of the Atlantic will be watched carefully by their allies and adversaries all across the continent.

It might be well, then, to examine in brief a few of the more important problems to which they will address themselves . . .

The economic race with the Soviets, despite the recent debacle in Paris, is still very much with us, and its political implications for the electric utility industry cannot be disregarded. Only last month three US Senators introduced a resolution calling for continued joint studies by the Senate Public Works and Interior committees on relative power development in the US and Russia. The industry will have to continue to point up the real meaning of this comparison, but a simple reiteration of kilowatt statistics is not enough: Perhaps the EEI board in Atlantic City ought itself to consider a resolution—calling on the government and offering it assistance to see that power resources in the less advanced areas of the world are developed, and developed by Americans.

PROCUREMENT & PRODUCTS ▶ **What accessories do you have on the cars in your standard fleet?** You might make some comparisons with the results of a 27-company survey made by American Gas Assn **(p 66)** . . . Moloney has new power transformer core which cuts sound energy generation . . . Westinghouse develops 5-kw thermoelectric generator **(p 68)** . . . Current transformer has BIL rating of 900 amp . . . Power fuse has fiberglass fuse holder and contacts that prevent damage under heavy fault conditions **(p 74).**

MANAGEMENT ▶ **What's next for the fast write-off?** After six years of bickering and debate over the proper interpretation of Sections 167 and 168 of the Internal Revenue Code of 1954, the state commissions are still showering utilities with every ruling imaginable. A nationwide roundup, based on a survey by Ebasco Services, in this very muddled area starts on **page 79.**

SELLING ▶ **Philadelphia gets an all-electric apartment house,** reportedly largest in the country. Details of the 13-story building on **page 85** . . . Readers Digest publishes street story on crime, safety **(p 86).**

NEXT WEEK ▶ **Nation's largest shopping center is served with 11 kv underground.**

The shift in public power emphasis to transmission grids—preferably giant ones built federally—must not go unnoticed. The fact that extensive regional power pools, developed by the private companies, are already in existence, and that they are doing much of what is being called for, must be made clear to the American people and their representatives in Washington. As we have said in these pages before, this "giant power" issue, though not new, may blossom into one of the biggest fights for the private companies.

New sources of power generation are still another matter which the conventiongoers will have to examine. The companies must constantly demonstrate their ability and willingness to develop these sources through intensive—and not always immediately profitable—research. They have done and must continue to do a commendable job with the atom. Likewise, they will have to push hard their good start in magnetohydrodynamics, thermoelectricity and hydrogen fusion.

The status of regulation in the US, as this week's Management Newsletter (p 79) points out with respect to accelerated depreciation, is a mess of contradictory and confusing legislation.

The near future will see a thorough review and revision of regulatory laws and practices on both the federal and state levels. Now is the time for investor-owned utilities to begin formulating their ideas and positions for the coming changes.

These, then, are some of the important matters that will infuse the salt air on the boardwalk in Atlantic City. The results of how EEI deals with them will be with us long after the beach carts are put away.

Executive Reader

Smaller conductors than before thought feasible can be used for 230 kv. Public Service Co of Colorado has established this through EHV tests which investigated corona loss and radio interference. The utility will put up a transmission line, which will be 230 kv later, and will spend 26% less on wire smaller than its prior standard. **Electrical West Industry News Letter, May 15, 1960.**

Utility employee efficiency can be determined through applying work measurement units. Such units are man-hours or crew-hours per job and are applicable to types of work that these personnel do repetitively, such as pole setting and transformer overhauling. By logging, then comparing work measurement units for their men or crews, the foreman and supervisor can establish par values for these repetitive jobs and can see which personnel are the sub-par performers that need extra training or should be transferred to other work. Management can also decide from such figures what jobs can be done more cheaply by outside contractors. **Work Measurement Units for Utility Employees, M. H. Diels, Public Utilities Fortnightly, May 26, 1960.**

Rural consumption will be 350% of today's by 1975. Not only will the use per customer rise to more than double, but increasing population and the spread of suburbs will be significant. In another quarter century, the co-ops will be serving more non-farmers than farmers. In fact, farms will continue to grow in size, so there will be fewer farmers. But these will step up their use of machines, hence of their electric consumption. The expected 1985 sales of 89 billion kwhr compares with 25.3 billion now. **Rural Lines, April-May, 1960, REA, U. S. Dept. of Agriculture, Washington 25, D. C.**

Although "remarkable things are being done with small-size fuel cells," says Dr Walter Zinn, Combustion Engineering vice president, they are a long way from becoming "appropriate" for electric utility systems. He further stated to his company's stockholders that nuclear power, magnetohydrodynamics, thermionic and thermo-electric effect sources are unlikely to change the generation picture much in the next few years.

New cathode ray tube prints on non-sensitized paper and other dielectric materials. This tube is for computer readout, recording at remote stations, projecting transparencies and addressing, for examples. The tube works with a pigmented powder released as a cloud close to the paper's surface. The image or writing on the paper is fixed by heat or pressure, but can be erased before it is fixed. The process will also make multicolor reproductions on glass and plastic as well as on various types of paper. **Litton Industries, 960 Industrial Road, San Carlos, Calif.**

Highlights of 15 years of O-B participation in EHV experimental projects

When modern EHV history is being made, Ohio Brass is usually there. That's as true today as it was 15 years ago . . . as the following brief "history" shows:

1946 TIDD PROJECT - - the 500-kv experimental line at the Tidd plant of Ohio Power Company (under sponsorship of American Electric Power Service Corp.) yielded much of the background information for building practical EHV lines.

1956 LEADVILLE PROJECT - - the 500-kv experimental line of Public Service Corp. of Colorado has indicated the effects of high altitude on EHV transmission.

1959 PENELEC PROJECT - - the 460-kv experimental line of Pennsylvania Electric Co. will reveal information on EHV transmission over rugged mountainous terrain.

1960 APPLE GROVE PROJECT - - the 750-kv AEP experimental line continues the work begun with the Tidd project.

Ohio Brass has been proud to cooperate with the sponsors of these projects and with the other manufacturers who have participated. Individually and in cooperative effort, we are pushing forward the frontiers of Extra-High Voltage transmission!

OHIO BRASS COMPANY, MANSFIELD, OHIO
Canadian Ohio Brass Co., Ltd., Niagara Falls, Ont.

Ohio Brass (B) HOLAN

PORCELAIN INSULATORS • LINE HARDWARE • CAPACITORS • LIGHTNING ARRESTERS
BUSHINGS • HOLAN TRUCK-MOUNTED POWER DEVICES AND BODIES • BRONZE VALVES

10027-H

NOW

Alcoa aluminum patented integral web channel bus available in 8 sizes

You can now get **all** the advantages of aluminum integral web channel bus in a new broad range of sizes.

This patented* design, introduced by Alcoa in 1956, has been expanded to eight sizes, providing capacities from 2,800 to 12,000 amperes.

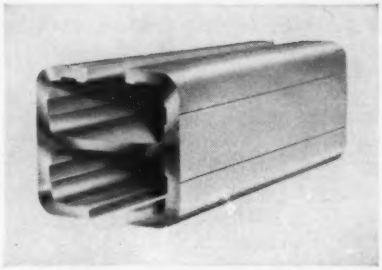
The web construction provides an integral shape for a bus conductor having unusual mechanical strength and high electrical efficiency. The large section modulus offers high structural strength to resist external loading and short-circuit stresses. The economical disposition of metal provides high current-carrying capacity at a low cost.

Moreover, you can make joints, taps, and splices by clamping, bolting, or welding. The table shows the sizes, capacities and weights from which you can choose to meet your exact needs.

Additional sizes can be designed to meet other specific needs. For complete information, contact your Rome representative. Or, if you'd like a copy of our "Alcoa Aluminum Bus Conductor Handbook," write: Rome Cable Division of Alcoa, Dept. 1-60, Rome, N. Y.

*PATENT NO. 2,904,621

Size	Nominal Current† (amperes)	Wt./ft. (lbs.)
4 x 4	2,800	5.4
4 x 6	3,500	7.1
5 x 6	4,050	8.9
5 x 8	5,000	11.7
6 x 6	5,000	14.2
8 x 8	7,000	19.0
11 x 11	10,000	31.0
12 x 12	12,000	38.0



†Based on 30°C rise above 40°C ambient still air

ROME CABLE
DIVISION OF **ALCOA**

Herman C. Stoelting, Development Engineer and well known authority on lightning protection, exhibits L-M's line of distribution lightning arresters. L-M offers the most complete line. Type E distribution arresters from 1 through 20 kv; Type SS high voltage distribution arresters in 27 and 30 kv; open gap Type TX arresters from 3 to 18 kv. The line includes some ratings not generally offered, such as 20, 27, and 30 kv.

L-M Offers Most Complete Line Of Distribution Lightning Arresters

Line Material, long a leader in lightning arrester development, recognizes the importance of proper arrester application. Arresters rated lower than the actual voltage requirements can be a frequent cause of trouble. Failure to consider system overvoltages and unbalance can result in arrester failure.

Line Material therefore offers a complete line, that permits the distribution engineer to make more accurate selection of the proper arrester to meet the requirements of the specific system, voltage, and location.

Get Details on Arrester Ratings, Features, Application

Ask the L-M Field Engineer for information on L-M Arresters and application data; or write Line Material Industries, Milwaukee 1, Wisconsin. In Canada: CLM Industries, McGraw-Edison (Canada) Limited, Toronto 13.

FOUR OUTSTANDING BENEFITS FROM USING L-M ARRESTERS

1. Long life; durability equalling station arrester standards, because of the characteristic element, plus lens electrodes in the element, and superlative moisture sealing.

2. Excellent protection of associated equipment; low impulse sparkover; high discharge capacity; generous margin of protection for transformer BIL. This has been proved by 20 years of field experience with some 2½ million L-M arresters now in service.

3. Prevention of line lockout by the L-M-originated Isolator (or external gap on Type TX). The Isolator was an L-M "first"—a vital contribution to the industry. The L-M Isolator has definite dependable time-current characteristics to permit accurate coordination.

4. Fewer operations of, and less wear on, sectionalizing equipment. With high follow currents, reclosers operate more frequently. L-M valve arresters have very low follow current due to the design, and back-up reclosers are called on to operate much less frequently.

LM®

LINE MATERIAL®
Industries

McGRAW-EDISON COMPANY

Lightning Arresters

452

McGRAW EDISON

DISTRIBUTION TRANSFORMERS • RECLOSERS AND OIL SWITCHES • FUSE CUTOUTS AND FUSE LINKS • LIGHTNING ARRESTERS • POWER SWITCHING EQUIPMENT
PACKAGED SUBSTATIONS • CAPACITORS • REGULATORS • OUTDOOR LIGHTING • LINE CONSTRUCTION MATERIALS • PORCELAIN INSULATORS • FIBRE PIPE & CONDUIT

LET'S TALK FUSE LINKS

■ Outwardly most fuse links look very much alike... but there the similarity ends! What then, makes Kearney Fuse Links more dependable... more accurate than others? ■ Let's start with construction. All Kearney Fuse Links feature LOW temperature fusible elements, and de-ion fibre-lined fuse tubes. Temperatures inside fuse tube and cutout cartridge remain well below the fibre charring point... even after prolonged service overloads. Thus, the all-important de-ion fibre is not impaired by excessive heat... fuse tube and cartridge retain their original strength and arc-quenching capabilities necessary for positive full-range fault interruption ■ The exclusive de-ion fibre lining and extra strength of the Kearney fuse tube, in effect, make the Kearney Fuse Link a cutout within a cutout when interrupting fault currents up to 600 amperes.* Extra-long, tough, moisture and weather resistant tube provides a longer de-ionization path to clear low faults faster, more positively... will not warp or hang up in cartridge. Fuse tube and top terminal are securely joined to prevent loss of expulsion gas pressure ■ Select components, rigid quality control, exhaustive laboratory and substation testing guarantee strict adherence of Kearney Fuse Links to published T-C curves. For positive system protection and accurate co-ordination... specify Kearney Fuse Links... Standard or Specialized.

*An average figure varying with different fuse ratings.

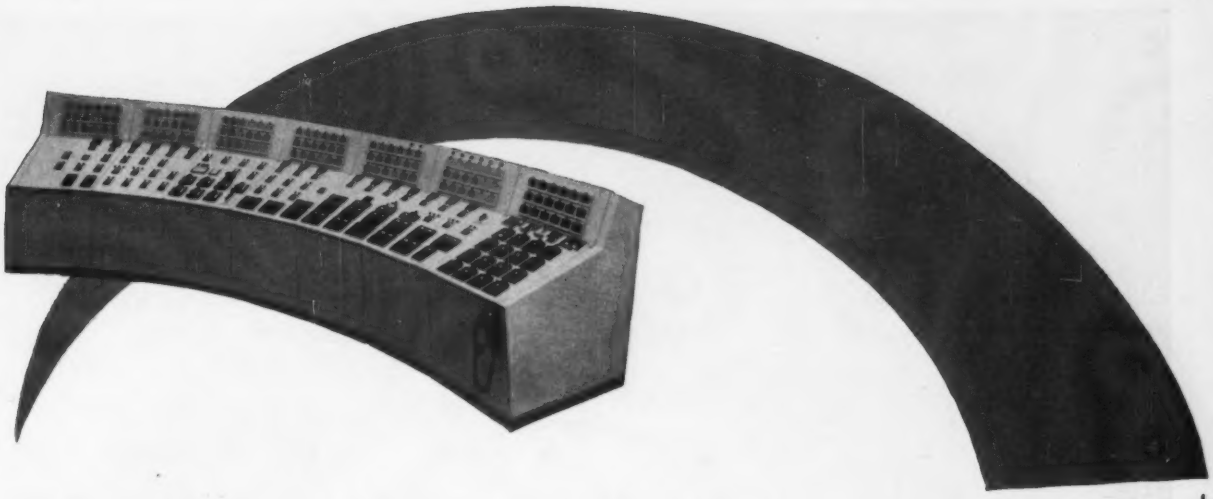
KEARNEY

for better construction... safer maintenance... specify KEARNEY products

JAMES R. KEARNEY CORPORATION

4224-42 Clayton Avenue, St. Louis 10, Missouri

PLANTS AT: ST. LOUIS • FAYETTEVILLE, ARKANSAS • SHENANDOAH, IOWA • CLARINDA, IOWA • GUELPH, ONTARIO, CANADA • ST. THERESE, QUEBEC, CANADA



Two industry leaders close the loop to give you...

COMPUTER CONTROL AND MONITORING SYSTEMS FOR MODERN ELECTRIC POWER STATIONS

The Thompson-Ramo-Wooldridge Products Company, the leader in industrial computer control with the RW-300 Digital Control Computer, and **Republic Flow Meters Company,** the leader in electronic combustion control, have "closed the loop" in the electric power industry. Through a cooperative plan, they have created a unique pool of engineering experience to give you these important advantages when planning automated power plants:

coordinated sales service
coordinated engineering service
coordinated installation and operation service

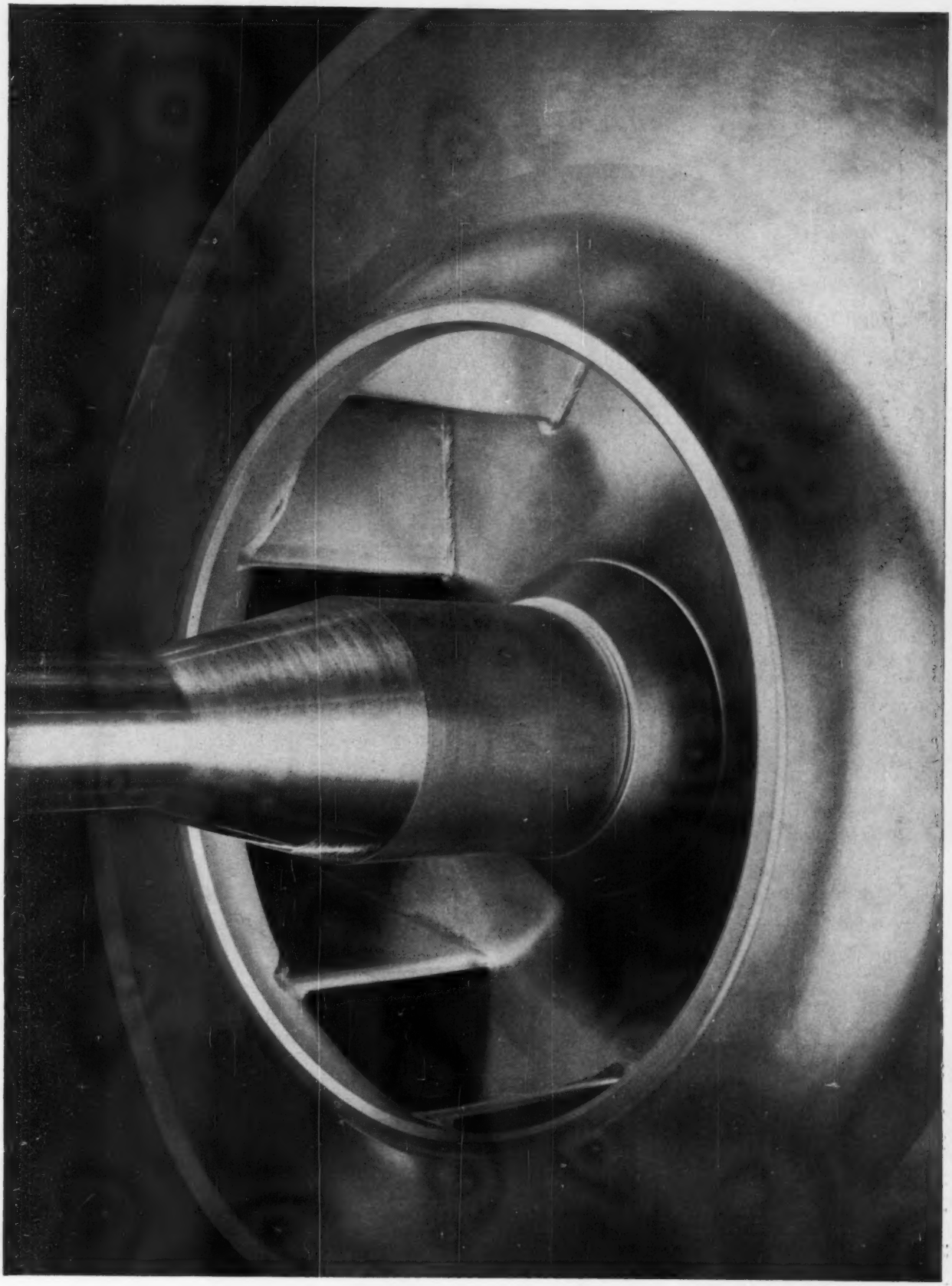
Republic Flow Meters Company (a subsidiary of Rockwell Manufacturing Company) has been a leader in pneumatic combustion control systems for over a quarter of a century, and during the last 10 years has designed over 125 electronic combustion control systems for steam generating plants. Republic engineering experience and product reliability in combustion control, feedwater control, superheat and reheat control, is assurance of system reliability.

The Thompson-Ramo-Wooldridge Products Company (a division of Thompson Ramo Wooldridge Inc.) has been the leader in developing industrial computer control systems for over five years. The RW-300 Digital Control Computer, designed specifically for closed-loop control and on-line data reduction, has demonstrated around-the-clock reliability in 16 industrial installations.

These two leading companies now offer coordinated engineering, installation and service for completely integrated control systems. Sales engineers located in principal cities throughout the nation can provide details of this cooperative plan, or either company may be contacted directly—Republic Flow Meters Company, 2240 Diversey Parkway, Chicago 47, Illinois—The Thompson-Ramo-Wooldridge Products Company, 202 North Canon Drive, Beverly Hills, California.

THE THOMPSON-RAMO-WOOLDRIDGE PRODUCTS COMPANY

a division of ***Thompson Ramo Wooldridge Inc.***



Engineering Excellence Pays Off In Operating Efficiency

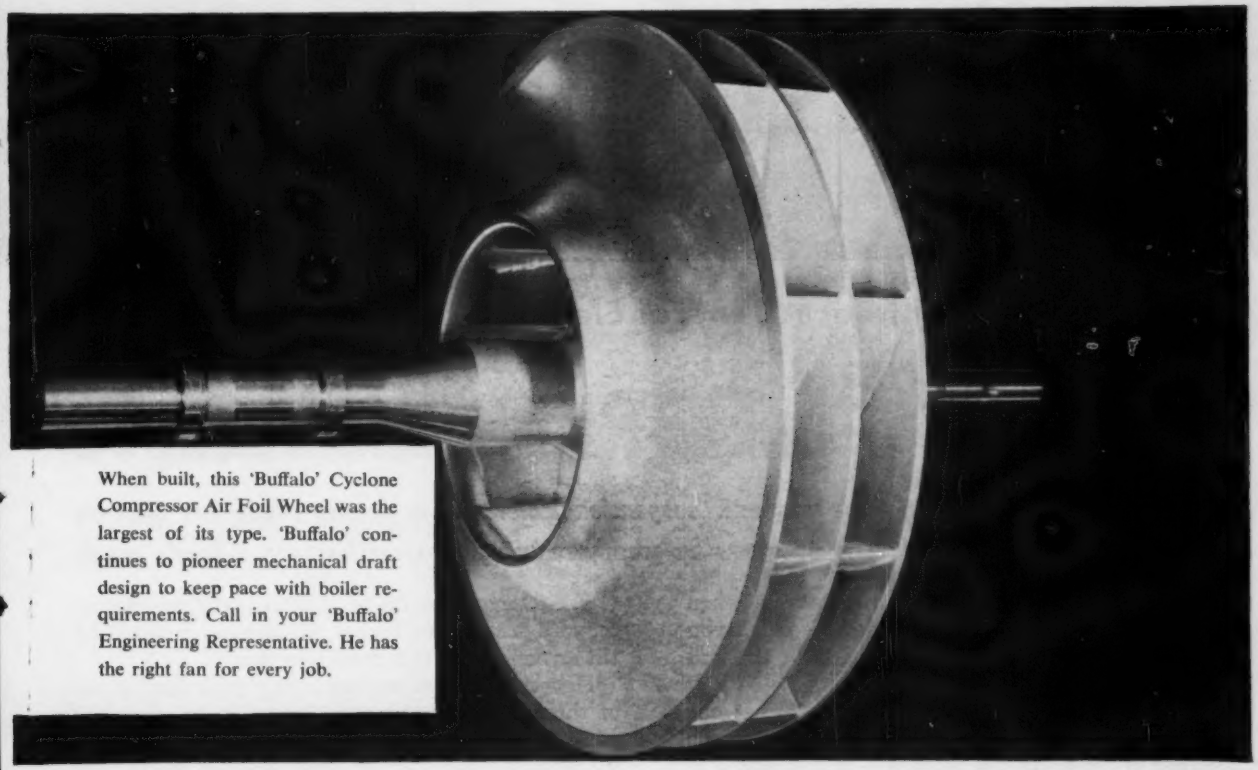
'BUFFALO' CYCLONE COMPRESSOR

HIGHLY EFFICIENT

Tailor-made to each job, these cyclone compressors provide power savings unobtainable with other designs. Exclusive engineering features such as generous inlet boxes, semi-circular inlet bell and matching wheel flange, deep air foil blades, streamlined scroll and divergent outlet all contribute to high static efficiency and lower noise levels.

TYPICALLY DEPENDABLE

Designed, engineered and built for years of continuous, trouble-free service. Hammered forgings, machined all-over, are used in all highly stressed areas. ¾″ steel plate is used in housings and ½″ plate in boxes. Engineered welding is double-checked by X-ray. Sleeve type bearings are supplied with circulating oil system where required. Engineered sound attenuators are available.



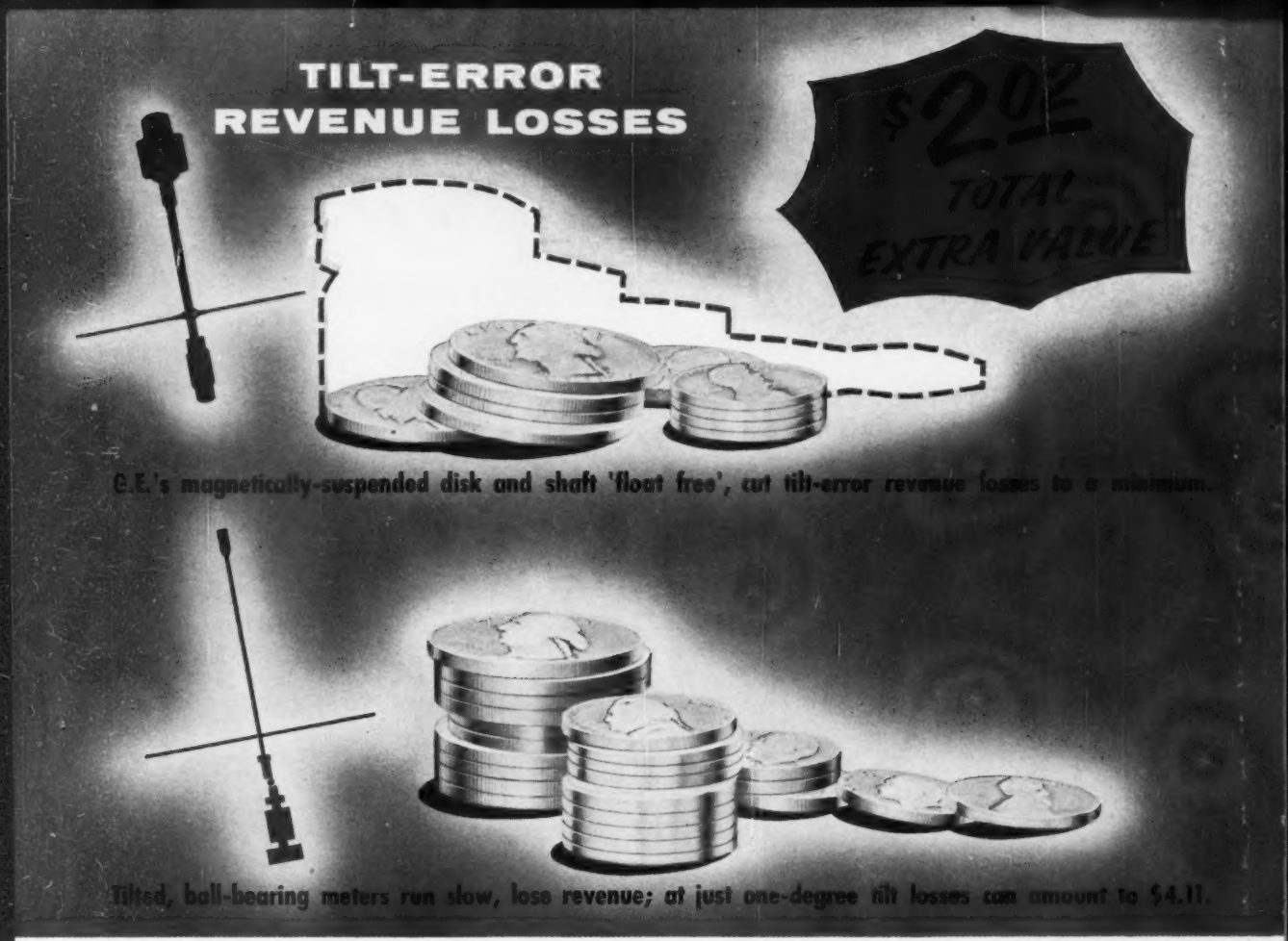
When built, this 'Buffalo' Cyclone Compressor Air Foil Wheel was the largest of its type. 'Buffalo' continues to pioneer mechanical draft design to keep pace with boiler requirements. Call in your 'Buffalo' Engineering Representative. He has the right fan for every job.

BUFFALO FORGE COMPANY BUFFALO, NEW YORK

Buffalo Pumps Division • Buffalo, New York

Canadian Blower & Forge Co., Ltd., Kitchener, Ontario

VENTILATING • AIR CLEANING • AIR TEMPERING • INDUCED DRAFT • EXHAUSTING • FORCED DRAFT • COOLING • HEATING • PRESSURE BLOWING


TILT-ERROR
REVENUE LOSSES
$2.02
TOTAL
EXTRA VALUE
G.E.'s magnetically-suspended disk and shaft 'float free', cut tilt-error revenue losses to a minimum.
Tilted, ball-bearing meters run slow, lose revenue; at just one-degree tilt losses can amount to $4.11.

Today's purchase of each General Electric I-60 meter provides . . .

Up to $2.02 in EXTRA VALUE because

Each General Electric single-phase magnetic suspension meter put in service today can increase gross revenue up to $4.11 in just 30 years by greatly reducing tilt-error losses . . . here's proof:

Old-style, ball-bearing meters lose revenue when operating in a tilted position. Just how much you lose depends on the degree and angle of tilt and meter load.

For example: a ball-bearing meter at just *one* degree forward tilt—operating at a continuous average of 240 volts, 3.0 amperes—in just one year would lose 5.7 kwhrs *more* than a General Electric I-60 meter mounted in the same position. In 30 years, this loss would amount to a sizeable 171 kwhrs. Using *Electrical World's* forecast for price per kwhr over the next 30 years, the gross revenue loss would be $4.11. Considering the 'present worth' factor at 6% interest for each of the 30 years, the *conservative* extra value realized today with each G-E I-60 meter would be $2.02, at only one degree forward tilt. Much higher savings are realized at tilt errors of 2 to 6 degrees (see chart).

How many tilted meters are on your line? Each of these meters represents a possible revenue loss of $4.11—or more—*unless* you have G-E magnetic suspension meters which offer greatest protection against substantial tilt-caused losses. By magnetically-suspending the disk and shaft in G-E meters, friction and disk displacement—major causes of tilt losses—are minimized.

For the complete "extra value" story on General Electric meters, contact your G-E Apparatus Salesman, or write General Electric Co., Somersworth, New Hampshire. 713-02

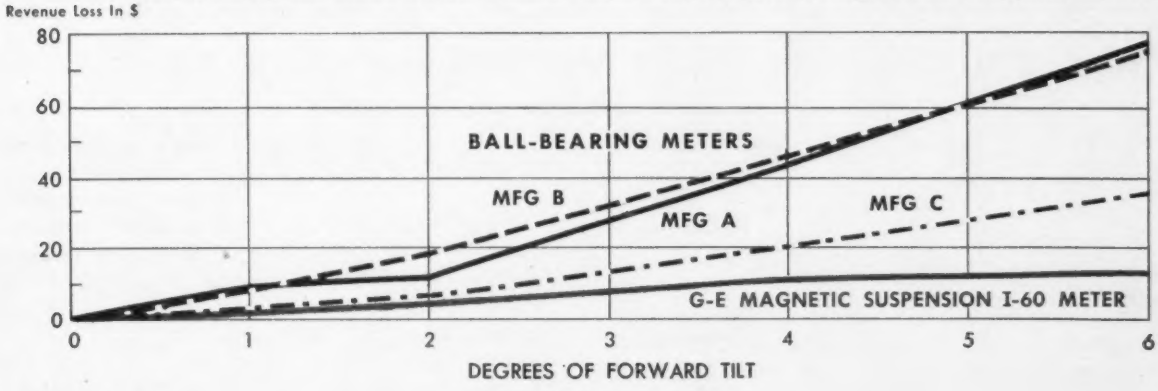
In metering, anything less than the best is too costly

SERVING MEDALLION HOMES
EQUIPPED BY GENERAL ELECTRIC

MEDALLION HOME
LIVE BETTER ELECTRICALLY

# of Reduced Tilt-error Revenue Losses

TILT-ERROR REVENUE LOSS IN 30 YEARS—Class 200, 3W, 240V, Single-stator Watthour Meters



METER DEPARTMENT

GENERAL ELECTRIC

After 200,000 hours Public Service Company of Indiana, Inc.

GULF MAKES THINGS

Seven years ago Public Service Company of Indiana, Inc. selected Gulfcrest oil for the first two turbine generators in its Wabash River Generating Station, Terre Haute, Indiana. Now numbering five, this station's generators have spun through more than 200,000 trouble-free operating hours with the help of Gulfcrest oil.

Recently, a sample of Gulfcrest was taken from one of the first two units installed at the station. Analysis showed it was practically the same as new oil. Here are the facts and figures:

	Original Properties	After 40,430 Hours
Color, ASTM Union	1.25	2.25
Flash point, °F	410	415
Appearance	Clear	Clear
Water, % by volume	0	0
Viscosity, SSU at 100°F	151	152.4
Neutralization No.	.04	.03
Interfacial tension, dynes per cm at 77°F	24	29

Control panel readings are taken on rigid schedules at Wabash River Generating Station of Public Service Company of Indiana, Inc. to assure dependable power service in the Terre Haute area. In foreground: C. Lloyd, Control Assistant.

A. Jerrels, Shift Supervisor, right, with Gulf Sales Representative Marshall Ringo. Gulf has been providing lubrication counsel to Public Service Company of Indiana, Inc. since the first two turbine generators were installed seven years ago.

finds Gulfcrest® oil as "good as new"...

RUN BETTER!

Performance records like this are attributable to advanced refining and treatment of selected base oils. Nine different processing operations are performed on the base oils to produce the finished Gulfcrest.

In many large turbine generators Gulfcrest has served continuously for more than 20 years, with neutralization numbers still low, systems still free from sludge and rust. Small wonder that in Gulf's marketing area, more power is generated by central station steam turbines lubricated with Gulfcrest than with any other oil.

For more information on Gulfcrest, call your nearest Gulf office or write for free copy of illustrated booklet.

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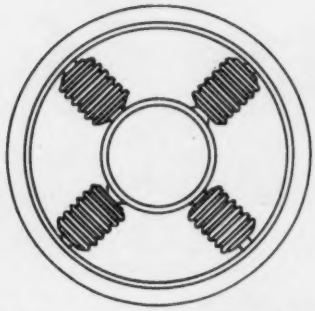
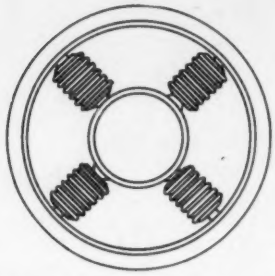


Standard Bus—Up to 90°C The AIEE standard, coupled with I-T-E quality construction—lowest losses.



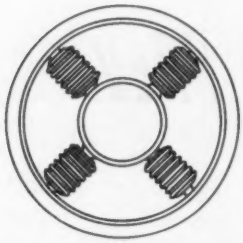
High Temperature Bus—105°C Reduces conductor size by 15% with correspondingly lower cost—but with increased losses.

Pick the bus that saves you the most

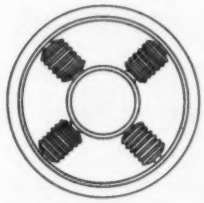
Only I-T-E Isolated Phase Bus is available in such a variety of designs to save you money. Your selection of the type of bus to buy depends on evaluation of both original cost and losses, plus careful consideration of the desired method of operation.

All I-T-E bus types are backed up by the engineering and laboratory experience of I-T-E. Design constants are so well known from theory and test that the most economical conductor to use for any ampere rating and voltage has been computer calculated.

Get full details on I-T-E Isolated Phase Bus. Write for Bulletin 2604-1A. I-T-E Circuit Breaker Company, Dept. SW, 1900 Hamilton Street, Philadelphia 30, Pa.



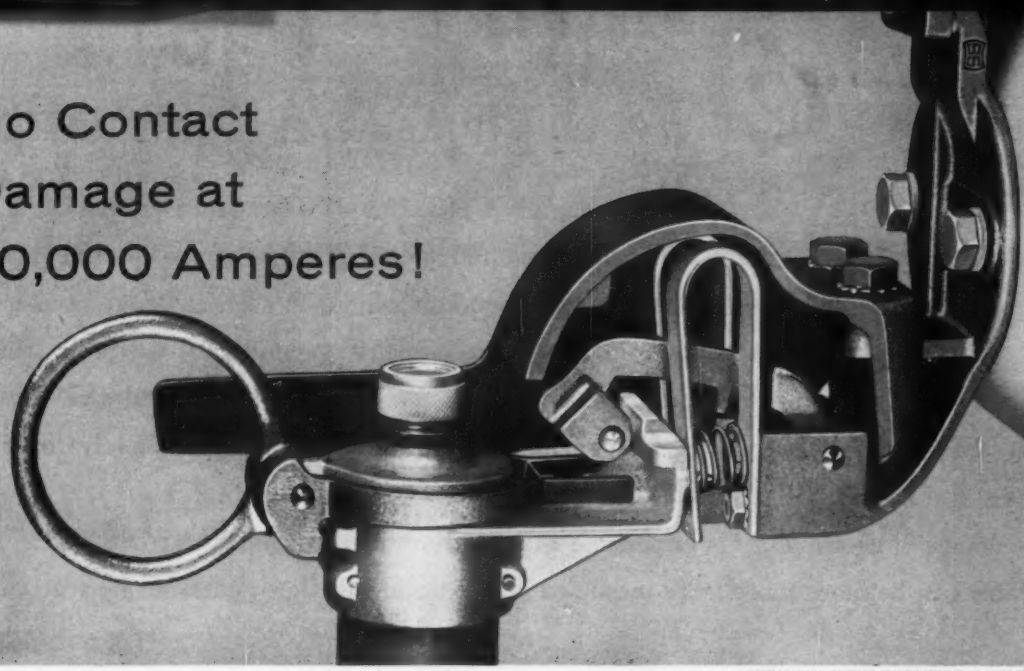
Forced-Air Cooled Bus Even smaller in size, with still lower material costs —still higher losses.



Liquid-Cooled Bus Minimum conductor size—highest losses.

I-T-E CIRCUIT BREAKER COMPANY

No Contact
Damage at
40,000 Amperes!



CUTAWAY VIEW SHOWING AMPLITACT® CONTACT

SOUTHERN STATES' POWER FUSES EMPLOY AMPLITACT® CONTACTS TO PREVENT CONTACT DAMAGE

Now, for the first time, "switch-proved" Amplitact® contacts are used on Southern States power fuses. Repeated tests at current ratings up to 40,000 amperes show no contact damage.

Used successfully for many years on Southern States air switches, Amplitact® contacts are now used on the new BPA and HPA Power Fuses.

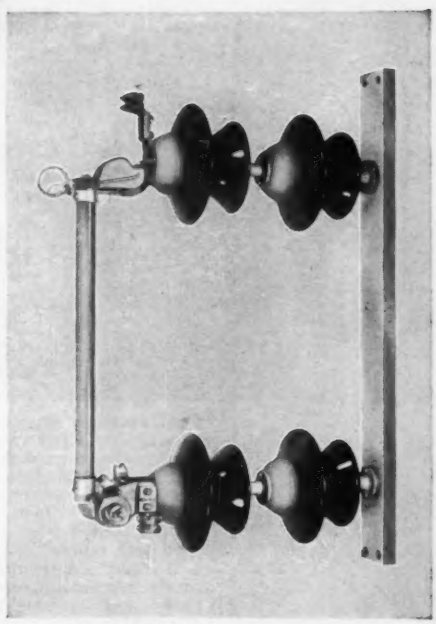
The Amplitact® harnesses electromagnetic forces generated on a high fault, increasing contact pressure when it is needed most.

While contact damage under extremely high fault currents has been more irksome than serious, the Amplitact® eliminates any possibility of damage.

These new power fuses have all of the outstanding advancements of the BP, MP, and HP power fuses introduced by Southern States in 1959—plus the reverse-loop contact. They have expendable cap fuse holders to provide dependable clearance of high or low current faults. Fuse holders are designed for easier handling and are equipped with a large operating eye. A stationary sleet shield gives better protection against icing and provides guidance when the fuse is slammed closed.

Low cost refusing in the field is accomplished with easy-to-use fuse kits.

Get your Southern States representative to give you full information about this important development in power fuses, or write direct for Bulletin 60 PF.



TYPE HPA POWER FUSE

KEEP PACE WITH ELECTRICITY

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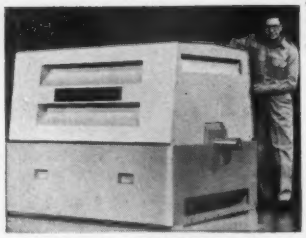
SS

SOUTHERN STATES
EQUIPMENT CORP.
HAMPTON, GEORGIA



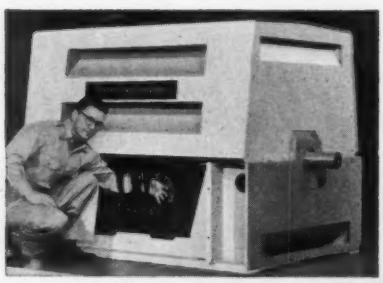
MORE VALUE FOR YOUR LARGE MOTOR INVESTMENT . . .

how Westinghouse F/A Motor design

What's new in inspection procedures for large motors? Less of it . . . up to 75% in both time and dollars directly chargeable to this chore.

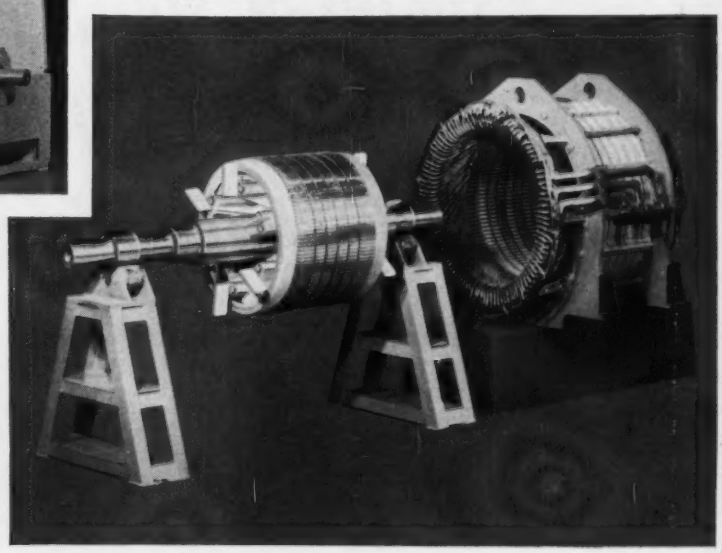
The reason Westinghouse can offer such unusual savings in inspection and maintenance is the revolutionary new F/A Motor design. For the first time, here is full accessibility coupled with the time-tested and -proved reliability of Westinghouse motor components. The motor housing is completely separate from the stator and can be removed in minutes for thorough visual inspection.

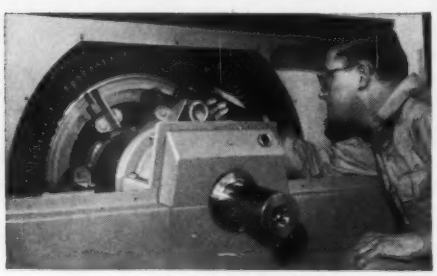
This degree of accessibility is impossible with conventional motors. As a consequence, the F/A Motor can be more thoroughly inspected and maintained, thus guaranteeing true value



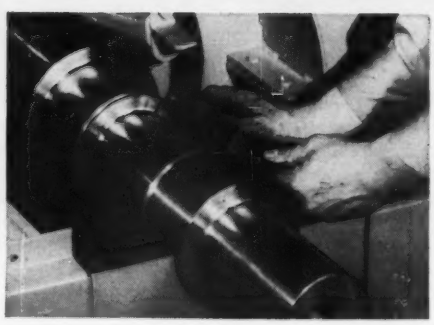
Inspection of leads and connections is simple. There are no protruding conduit boxes; cable comes up through the base, leaving plenty of room for connecting motor leads.

Disassembly as complete as this is impossible in conventional motors. With the Westinghouse F/A Motor it *can* be done, and in only 90 minutes. Reassembly takes only 2 hours, for a total of 3½ hours for a complete dismantling.





For routine inspection of windings and bearings, simply remove the end panels (above). **For complete bearing inspection,** merely remove bearing cap, top bearing shell and oil ring; then bottom bearing shell rolls out for easy inspection (right). **For more thorough inspection,** end covers, panels and air shields can be removed in only 38 minutes and replaced in 56—with the motor still in running condition!



YOU CAN BE SURE...IF IT'S

cuts inspection time and costs as much as 75%

and long life for your large motor investment. Speedier work saves up to 75% of the man-hours and money usually expended in these procedures. Outages, too, are fewer and shorter.

In addition, these bonus values are yours in the F/A Motor—Thermalastic® insulation, with super-reliability proved in over 50 million kw of Westinghouse large rotating apparatus since its development 11 years ago; extra quietness, virtually eliminating the shrill screech of the typical large motor.

You'll want more information on this most modern of all large motors. Call your Westinghouse representative, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

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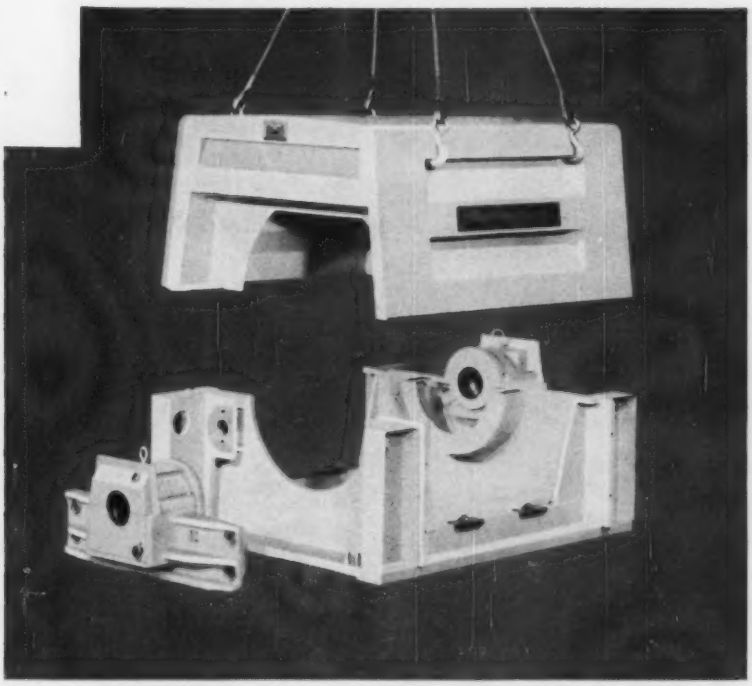
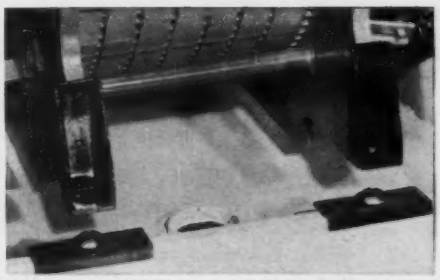




Special ball-and-socket type locator joints simplify removal and replacement of stator in annual inspections. In reassembly, perfect realignment is automatic.

COMPARE! How much time are you spending on large motor inspections?

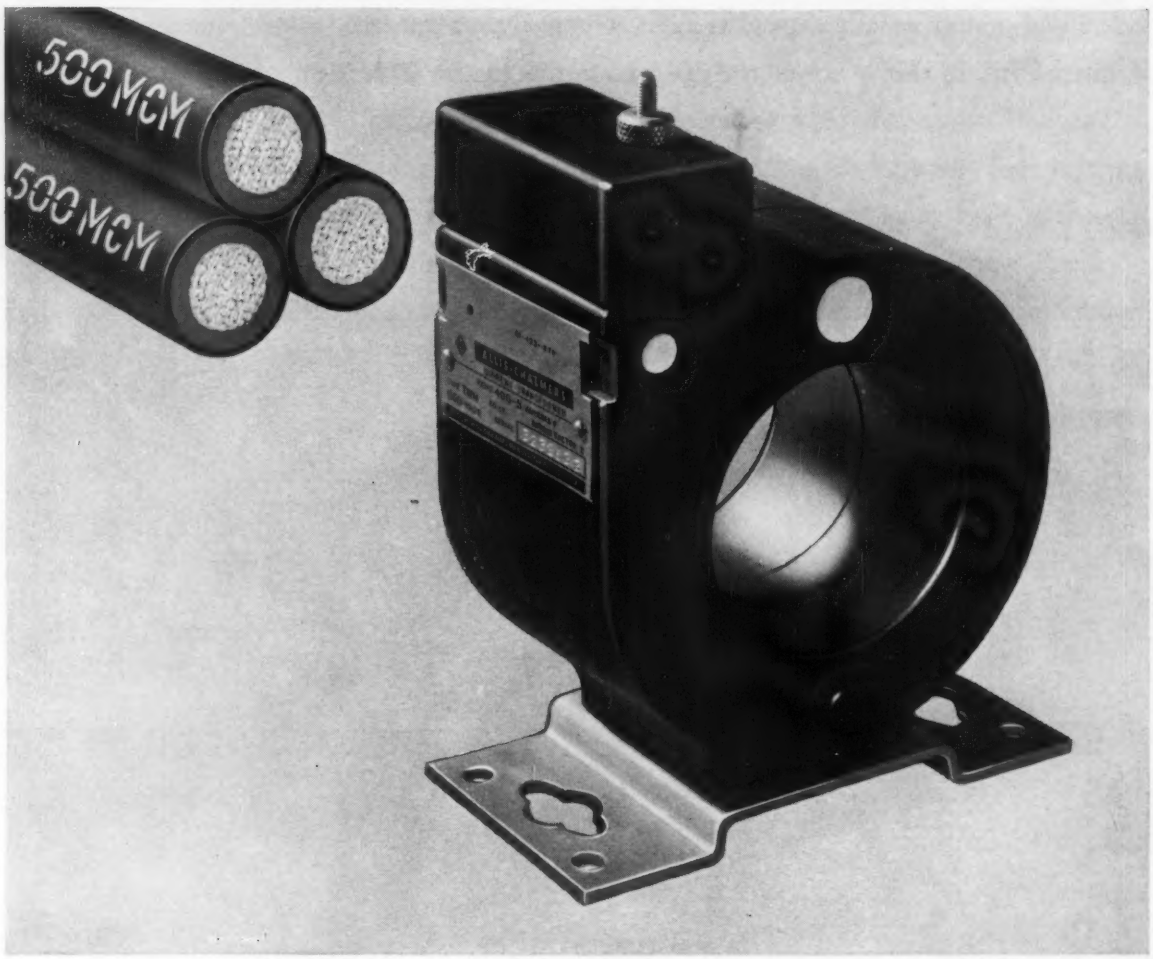
USE THIS SIMPLE CHART TO MAKE YOUR OWN COMPARISON TESTS!

INSPECTION OPERATION	TIME—F/A MOTORS	TIME—YOUR MOTORS
Routine: Including windings, bearings and leads.	Removal of panels and shields—38 min. Replacement—56 min.	
Annual: Including complete teardown.	Disassembly—90 min. Reassembly—120 min.	

Westinghouse

TUNE IN WESTINGHOUSE-CBS TV-RADIO COVERAGE, PRESIDENTIAL CONVENTIONS, JULY 10-29

ALLIS-CHALMERS



Lightest weight with largest window

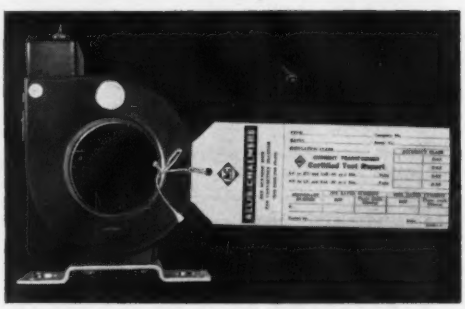
and the best accuracy available on the market today

The NEW Allis-Chalmers "PICTURE WINDOW" current transformer can easily take three 500 MCM cables.

Compact, easy to install, indestructible and weatherproof — this 600-volt epoxy-resin transformer will withstand wide temperature variations and the most severe mechanical shocks. Eliminates all possible maintenance.

Easily adapted for conduit-type hookup, A-C current transformers can be used on 2 or 3-wire, single and polyphase circuits. Ratings: 200, 400, 600 and 800 amperes.

Get full details on this NEW TWM current transformer from your nearby A-C office. Or write **Allis-Chalmers,** *Power Equipment Division, Milwaukee 1, Wisconsin.* A-1310



Verified accuracy! Certified test card accompanies every A-C unit shipped. This A-C design provides ample overcurrent capacity without reduction of accuracy.

Editorial Comment

JUNE 6, 1960

Civic Responsibility, National Size

Utility managements increasingly preach civic responsibility on a local level. They know the tremendous public relations value.

Why can't this civic responsibility be extended to the national and even international scene?

Of course, it has been to some extent. Prominent utility executives have put their personal time at the national government's disposal for vital tasks. Detroit Edison Co's Walker Cisler comes quickly to mind, and there are others. Many have served on national committees, giving freely of their counsel when called upon. We're sure this has enhanced the public's image of the private utilities, although we're not sure the public couldn't have been told more adeptly.

But there hasn't been enough of this sort of thing. As times change and the world becomes more complex, government and industry are thrown together more closely and more often. Government, whether admitting it or not, badly needs the cooperation and wisdom of key industry figures and of industry itself.

With this in mind, we are calling for an EEI resolution (p 20) offering to place utility industry resources behind a vital area in the world-wide struggle against communism. Deliberately, we've spelled out no details. There are many ways this cooperation can be offered.

We sincerely believe that the utility industry for its own sake should expand the scope of its excellent civic responsibility efforts. And we can think of no better arena in which to do it.

Reimbursement Black-Out at ARWA

It might be thought that reimbursement for relocating utility facilities would have been one of the livelier subjects at the recent annual seminar of the American Right of Way Assn. Not so. The issue was blacked out completely. In so doing, ARWA deliberately dodged one of the key controversies about the highway program.

What is wrong with discussing the subject? When highway and utility right-of-way experts can so effectively discourse on advance planning and coordination, why shouldn't they bring their expertise into play on who is to bear the cost?

ARWA officials, of course, have a ready answer. Theirs is an educational, professional organization—not political. True. But if ARWA members cannot give direction and assistance on this vital, controversial question—who can?

The federal highway program is advancing, and thanks to right-of-way men—many ARWA members—so is understanding and cooperation on the physical side of relocation. Legislation is moving along too in several different directions. But the question of reimbursement often hangs by its heels.

The right-of-way professionals, with their increasingly successful liaison between diverse interests, are whacking millions from the cost of relocating facilities. ARWA has provided a powerful rostrum for their collective efforts.

We believe that these professionals should be permitted to give uniformity and stability to the reimbursement problem in the same way they achieved success on reducing costs, by talking about the problem.

Too many professional societies, by hiding behind the guise of political purity, have denied their members the means of settling controversial questions. We hope ARWA comes out of hiding.

'Code of Ethics Bill May Come From

Also, subject of Federal Power Commission appointments seen as possible political issue in coming national election

Two possible developments appear to be growing out of the recent hearings of alleged Federal Power Commission "influence" activities. They are: (1) possible enactment of a mild "Code of Ethics" bill by Congress this session; (2) a Senate drive to extend the term of FPC Commissioner William Connole.

The recent hearings on FPC ethics failed to turn up any definite charges against the Commission, but they did improve the chances for enactment of a mild bill aimed at preventing some of the activities which were charged against the FPC in the hearings. Such a bill might be HR-4800, introduced by Rep Oren Harris (D-Ark.), chairman of the House Commerce Committee—whose Legislative Oversight Subcommittee held the hearings.

Harris' bill would make it illegal to communicate with commissioners on issues, merits of disposition of active proceedings, without doing so in writing and placing a copy of the correspondence in a public file.

In addition, the bill (HR-4800) would require the FPC to keep a roster of persons representing private interests, including the proceedings in which the persons are interested. A year's imprisonment, a $10,000 fine, or both, would be punishment for violators of the law. FPC commissioners and staff members would be subject to reprimands or dismissal for accepting anything of value from those doing business with the FPC—from "unusual hospitality," to "favors" or "services." Finally the bill would permit the FPC to choose its own chairman, rather than delegating that power to the President.

The Harris bill is expected to pass the House during June, but its passage of the Senate is less certain.

A political catalyst in the bill's favor is the coming national election. Washington observers point out that enactment of such a "ethics" bill would tend to sharpen the Democratic charges of "corruption" in the Eisenhower Administration.

Demos Will Stall Confirmation

The national elections also are being eyed by the Democrats in regard to the office-terms of holdover commissioners on all regulatory agencies, including the FPC. Confirmation of the new Eisenhower appointees to the FPC would keep the GQP stamp on the FPC well into the next administration until the terms of Commissioners Kuykendall and Kline come to an end in 1962.

If the nominees aren't confirmed —holdover members appointed after Congress adjourns instead— then a new President would be able to nominate his own choices next January.

Sen Warren Magnuson (D-Wash.) will open hearings June 7 on his new bill to permit commissioners to stay in office until their successors have been nominated and confirmed. Under such a bill, Connole would be able to stay in office until the Senate confirmed his successor. Since Magnuson's committee must hold hearings on confirmations, it is clear that Eisenhower could not expect the Senate to act on a replacement nomination as long as Connole stayed in office.

Presumably, in Magnuson's thinking, a new Democratic President could nominate Connole for a full term next January.

Magnuson also is planning a broad-scale study of all regulatory agencies, FPC included, on how and why these agencies are "getting further and further behind in

Pumped Storage Project Is Started

This is an artist's concept of the upper dam in the Smith Mountain project of Appalachian Power Co. The dam will be built at Smith Mountain Gap on the Roanoke River in Virginia, about 45 miles downstream from Roanoke and 33 miles northwest of Danville, Va.

The dam will be about 225 ft high, with the spillway about 200 ft high and 810 ft long. Sollitt Construction Co, South Bend, Ind., has started general construction work. Langenfelder & Sons of Baltimore is preparing to start excavation work. It is estimated that 250,000 yards of earth and rock will be removed.

Hearings

their work despite the fact that we have appropriated more and more money for additional personnel."

He said that persons dealing with the commissions "are disgusted." And he said his committee wants to find out whether the fault lies with present laws, "too many commissioners, ineptness, or many other things."

Magnuson's committee has held one preliminary hearing on Eisenhower's two nominees to FPC: Paul A. Sweeney (to succeed the late John B. Hussey) and Thomas A. Donegan (to replace Connole). Donegan hasn't decided whether he will accept an interim appointment after Congress adjourns.

Connole Has Johnson Support

Senate Majority Leader Lyndon Johnson (D-Tex.) has indicated the Senate might hold up also on Donegan's confirmation. He said "It would have a happy effect on the Senate if President Eisenhower would withdraw the nominations (of Sweeney and Donegan) and resubmit Mr Connole, or someone with a background of experience in the regulatory field . . . responsible consideration of nominations by the Senate does not mean okaying them with a rubber stamp."

Connole, however, made it plain that he intends to leave office on June 22 when his term expires, regardless of Congress' actions.

The question of new nominees to FPC was brought into the spotlight because of the coincidental disclosures before Harris' subcommittee of alleged, improper ex parte contacts with FPC commissioners by Thomas G. Corcoran, a Washington lawyer-lobbyist representing Tennessee Gas Transmission Corp and its subsidiary, Midwestern Gas Transmission Corp.

Congress, the courts, and the administration have failed to tell the commission how to regulate the natural gas industry, and the result has been to bog down the regulatory process to the point where companies have to "nag" the commissioners privately to get anything decided, Corcoran said.

As general counsel to Midwestern Gas Transmission Corp—although not as its attorney of record before the commission—Corcoran talked individually with commissioners last October while they were deciding the company's bid to import Canadian gas into the Upper Midwest.

He was careful, he testified, to approach the commissioners on a "procedural" basis to spur them to promptly issue a decision with terms his company could accept. But, he conceded, "All procedure is related to a set of facts . . . and by some umbilical cord connection to the merits" of the case.

Corcoran relied heavily on Kuykendall's statement that the commissioners consult staff members while they are deciding cases. The attorney insisted that in proceedings in which the staff is the company's only opponent, the company is entitled to the same privilege of talking to commissioners.

CONNOLE

CORCORAN

Interior Wants Revolving Fund

A special revolving fund for Bureau of Reclamation operations has been proposed in a newly-drafted bill, sent by Interior Department to the House of Representatives.

The Department's plan calls for placing of four Bureau activities in the fund: operation and maintenance, general investigations, general administration, emergency requirements. The fund would pay for these activities with money coming in from all revenues and receipts from Bureau operations, plus all Congressional appropriations.

Construction still would be subject to annual appropriations, as would be major rehabilitation, irrigation loans, Alaskan project investigations, soil, moisture-conservation and halogeton programs.

The proposed bill is intended to allow routine Bureau operations—totaling about $38 million this fiscal year—to be carried on without being subjected to appropriation delays and problems. The "results of the business-type operations of the Bureau would be reflected in the budget on a net basis" at the end of the fiscal year, instead of as estimates at the beginning of the period, the Department points out.

Contractors doing jobs for the Bureau still would have to reply on annual appropriations to finance new construction projects.

Asst Interior Secretary Fred Aandahl said the proposed bill would not decrease Congressional control over the Bureau's activities. Revolving fund money could be used for construction and rehabilitation of authorized projects only on approval by Congress.

The measure has little chance for enactment this year; it was sent as a proposal to Capitol Hill only "for the record." It is in line with a similar measure proposed for the Rural Electrification Administration, sent to Congress earlier this year—and on which no action has been taken.

Pennsylvania PUC to Probe Seven Utilities

A sweeping investigation of the current earnings of seven Pennsylvania electric utility companies to determine whether revenues are excessive was unanimously ordered recently by the Public Utility Commission.

The inquiry will not apply to Philadelphia Electric Co, which serves customers in Philadelphia, Bucks, Chester, Delaware, and Montgomery Counties; Pennsylvania Power & Light Co, operating in 28 counties; and United Gas Improvement Co, in Luzerne County.

The PUC said a review of reports of the three firms indicated their earnings did not appear excessive.

Companies subject to the inquiry serve a total of 1,625,000 customers and have $337,000,000 in gross annual operating revenues.

The affected companies were directed to meet with commission members within 30 days for preliminary inquiry discussion. They are: Metropolitan Edison Co, Duquesne Light Co, Pennsylvania Electric Co, Pennsylvania Power Co, Cumberland Valley Electric Co, West Penn Power Co, and South Penn Power Co. Commission action followed initial analysis of new quarterly reports covering operations of 10 of the largest utilities for the year ending March 31.

The check showed the seven may be over the line in their return on indicated plant fair value. The PUC said a generally accepted fair return is in the area of 6%.

The conference with the utilities whose rates appear too high, a PUC spokesman said, is aimed at determining whether they should make immediate reductions or whether formal public hearings are necessary to establish fairness of their charges. PUC said it would outline what further rate and financial data it needs and try for a course of action to insure an expeditious, fair and thorough investigation. Preliminary examination of the interim reports covering revenues, expenses and capital investments make it appear that the seven firms may now or in the immediate future earn an excessive return, considering presently determined or determinable factors, the PUC said.

Achievement Award to Seaway Project

Robert Moses (left) is accepting the Outstanding Civil Engineering Achievement Award for 1960 from Frank A. Marston, president of the American Society of Civil Engineers. The ASCE award was presented for the St. Lawrence Seaway and Power Development. Moses is chairman of the New York State Power Authority.

Aluminum Expansion To Follow BPA Power?

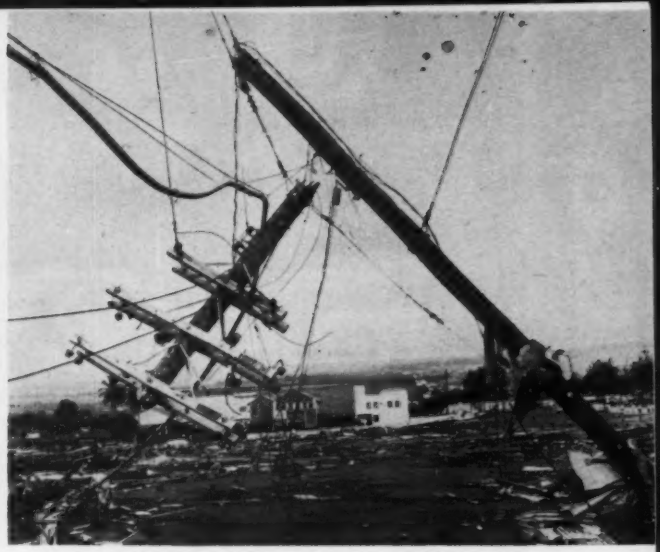
Another round of aluminum industry expansion will probably follow the announcement by Bonneville Power Administration that about 150,000 kw of firm and 400,000 kw of secondary power is available to Northwest industries.

Present customers have first priority for the power until June 17, and then the remainder will be offered to new customers. Harvey Aluminum Inc has had a request in for some time for 60 to 75 Mw of firm and 95 Mw of secondary power to be used in a proposed primary aluminum reduction plant expansion at The Dalles, Ore., or possibly in a plant across the Columbia River in Washington.

New power sales would bring BPA $5 million more annually.

It is estimated by BPA that the additional power would permit a $75-million industrial expansion.

Parking meters are bent like pins . . .



and poles are snapped like twigs, as . . .

Tidal Wave Knocks Out 70% of Hilo Electric

More than two-thirds of the generating capacity of Hilo Electric Light & Power Co was knocked out by the tidal wave that hit the city May 23.

When the third and biggest wave of the series that had started 15 hours earlier in Chile, 6,800 miles away, hit Hilo at 1:05 am May 23, the whole city was thrown into darkness.

Partial power was finally restored about 6 am but generators outside the wave area gave the firm only 9,000 kw capacity versus its normal 35,000.

However, the wave also knocked out some big power users (Honolulu Iron Works, the manufacturing plant of Flintkote Co) and reduced demand below the normal 20,000 to 21,000-kw level.

Three days after the wave, the power situation was improved considerably when the Navy oiler Millicoma arrived at Hilo and added its 5,000-kw capacity to the city's system. It was hooked in with the aid of 10,000 ft of cable sent from Hawaiian Electric Co in Honolulu, about 180 miles away on the island of Oahu.

Besides leaving soaked machinery and from 14 in. to six ft of silt in the main plant of Hilo Electric, the wave also knocked out its lines and poles in the central Hilo area. W. H. Hill, company president, estimated the damage at several millions.

Relatively little of the damage was covered by insurance. Tidal wave insurance is not available.

The Hawaii Public Utilities Commission began a study of the financial problem facing the utility. Its general practice is not to allow rate increases for capital improvement.

Hawaiian Telephone Co estimated 35 or 40% of Hilo's telephones were knocked out of order by the wave. It estimated its loss at over $250,000.

Hilo Electric began the job of cleaning out its plant, taking generators apart, washing them and baking them dry. It estimated it would be weeks before power would be normal again.

The problem of aid from Navy vessels was complicated by the fact that the first two ships assigned, both repair vessels, had direct current and there was no means available of converting it to alternating current.

Supplementary power also was supplied by diesel generators at the sugar mill of Hawaiian Agricultural Co, in the rural area served by Hilo Electric.

Report Reds Blueprint 1,000-Mw Turbine

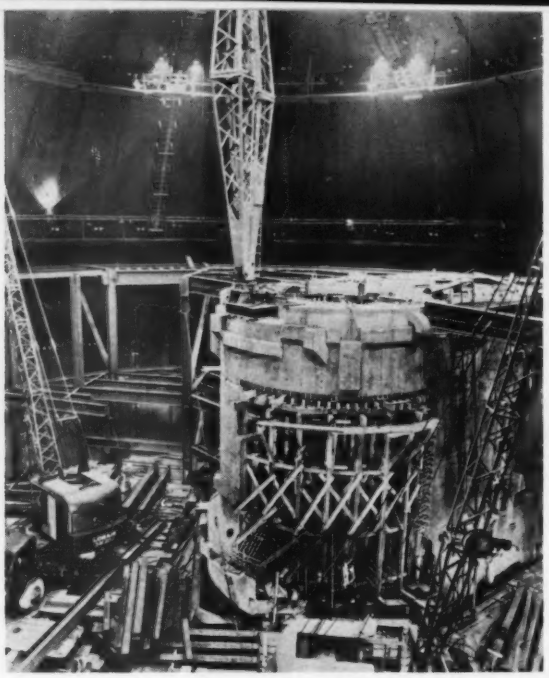
VIENNA (*McGraw-Hill World News*)—Blueprints for a 1,000-Mw steam turbine were completed recently by "Metal Works of Leningrad" and approved by the "Conference on Electrical Machine Construction," according to *Tass*, the Soviet news agency.

Tass states the new design was worked out on the basis of a 500-Mw, single shaft, three-stage turbine. Capacity was doubled by increasing the steam exhaust ports in the condenser, by using a new turbine blade, and by using two shafts and four stages one high-pressure stage, two medium-pressure stages, and a low-pressure one.

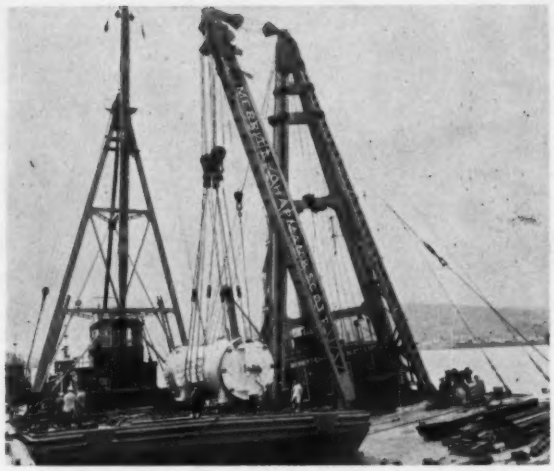
It is expected that the utilization rate of the new turbine set will be considerably larger as compared to the overall utilization of a larger number of individually smaller sets. The other advantages include faster construction time and considerable savings in metal used for turbine construction.

The *Tass* announcement was greeted with skepticism by several US power men who have pointed out that, according to reliable sources, the largest units in operation in Russia today are rated at 200 Mw. They add that the Soviets have completed building a 300-Mw unit and are working on a 500-Mw one, but that "these sizes are a long way from 1,000-Mw."

Indian Point



1 CONCRETE REACTOR ENCLOSURE is shown under construction within the Indian Point containment sphere



2 ARRIVAL of 230-ton reactor vessel by barge at site April 28 marked start of final phase of assemblage

Indian Point Nuclear Generating Station, under construction since December, 1956, had its nuclear heart delivered in late April of this year. Operation of the plant has been scheduled by Consolidated Edison Co of New York for 1961.

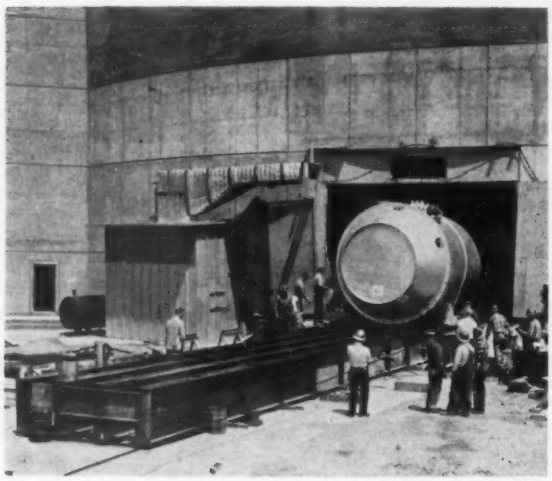
The 230-ton nuclear reactor vessel, fabricated by Babcock & Wilcox Co, arrived from Barberton, Ohio. The nuclear fuel for generating heat through atomic fission will ultimately be placed within this steel cylinder, which in a horizontal position resembled a small submarine. Its fuel will consist of small amounts of uranium-235 mixed with large amounts of fertile thorium-232.

Upon arrival by barge, the reactor vessel was loaded onto a 36-wheel, heavy-duty trailer and carried in a horizontal position to a temporary access hole in the west side of the concrete biological shield and steel sphere.

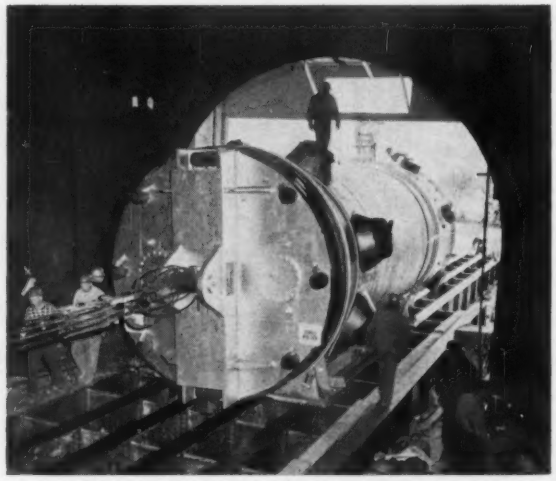
Eight 50-ton-capacity jacks then raised it to allow removal of the trailer.

Illustrations show how it was moved into the sphere and set upright in the concrete housing. Its installation required the erection of more than 220 tons of temporary steel as well as the use of some 1,400 tons of permanent steel beams and columns.

The reactor will be operated from a control room, no one being allowed to enter the outer concrete shield while it is operating.

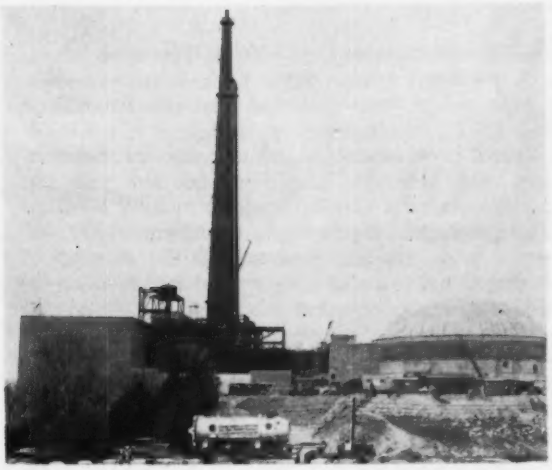


5 VESSEL moves inward, pulled by two 50,000-lb-capacity winches with associated block-and-tackle rigs

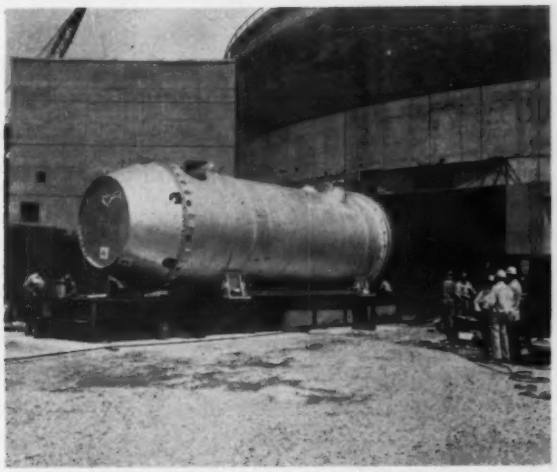


6 GREASED SKIDWAY facilitates trip of the 230-ton nuclear reactor pressure vessel to destined position

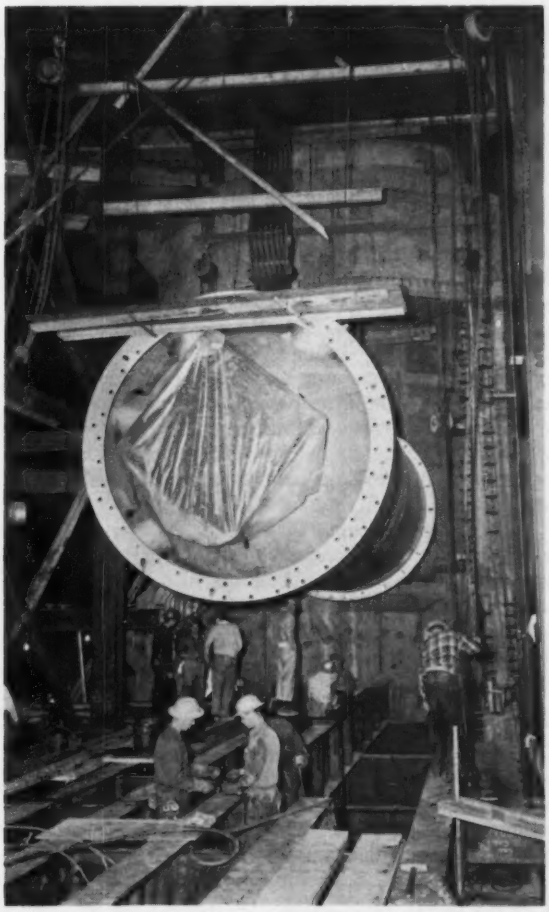
Reactor Vessel Delivered, Set Up



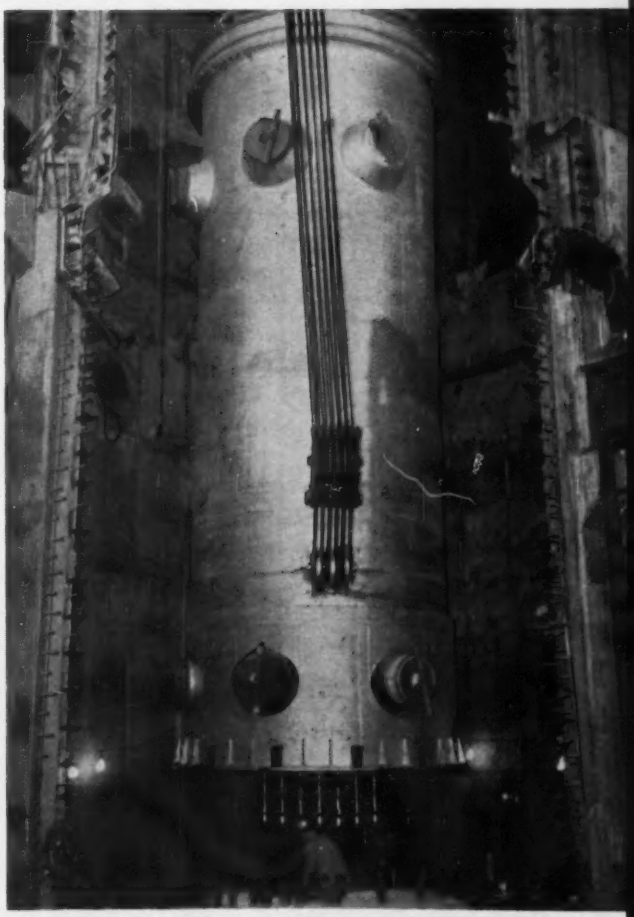
3 **BARGE-TO-SITE TRIP** was made by trailer. Conventional reheat plant with stack is in immediate background



4 **PRESSURE VESSEL** rests on temporary steel skidway at entrance to the concrete housing inside the sphere



7 **VESSEL**, which entered sphere top first, is raised and readied for placement in perpendicular enclosure



VESSEL is gently lowered for setting, like an egg on egg cup, after suspension in the horizontal overnight

New Method Guides Protection

Simplified approach gives quick, accurate analysis of requirements to protect generators of steam and hydro units against overvoltages caused by lightning

J. K. DILLARD, Manager Electric Utility Engineering
A. R. HILEMAN, Electric Utility Engineering Department, Westinghouse Electric Corp, East Pittsburgh, Pennsylvania

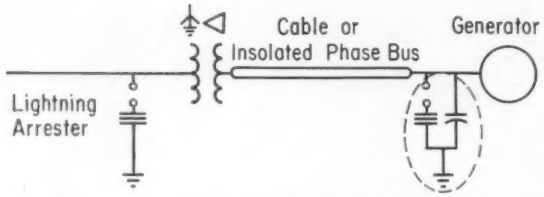


FIG 1. TYPICAL UNIT-CONNECTED GENERATOR has lightning arresters on line terminals at main transformers. Does it also need protection at the generator?

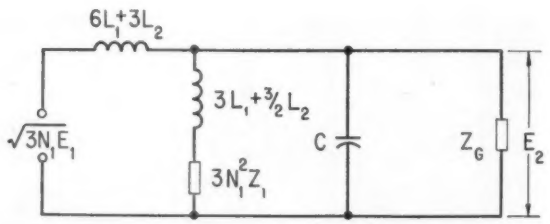


FIG 2. EQUIVALENT CIRCUIT gives surge voltage at generator terminals passing through a two-winding wye-grounded delta connected main transformer bank

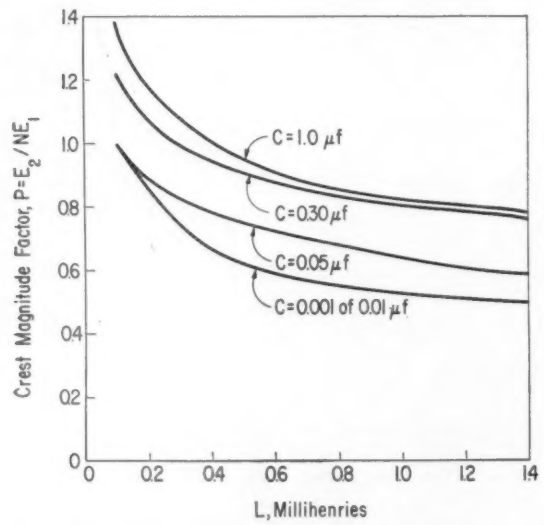


FIG 3. CREST MAGNITUDE OF SURGE VOLTAGE at generator terminals depends on L and C of circuit

Recent improvements in lightning arrester characteristics and generator insulation, coupled with the development of a simple, accurate method of determining protection requirements, as presented here, will spur a more realistic approach to the decision of whether or not to install arresters and capacitors on the terminals of unit-connected generators.

In the past, the decision to install arresters and capacitors was based on the philosophy that their cost is trivial compared to the cost of a generator and, while they may do no good, they will do no harm. However, with the increased desire to omit non-essential equipment and the increased premium on space, a re-evaluation of protection requirements is necessary.

Method Is Simple, Accurate

This article presents a simple, accurate, straight-forward method for determining the protective requirements. The method is applicable also to generators connected to the system through three-winding wye-grounded-delta-delta transformers found in some hydro stations.

A typical unit-connected generator is connected to the system as shown in Fig. 1. Lightning arresters at the high-voltage transformer terminals protect transformer insulation. When the arrester sparks over, its discharge voltage is transferred through the transformer and modified in magnitude and wave shape by the surge characteristics of the transformer, generator, and cable or isolated-phase bus. This surge impinges on the generator which has considerably less impulse insulation strength than oil-insulated apparatus. If the surge voltage at the generator terminals overstresses the generator insulation, arresters and/or capacitors should be installed. Arresters protect conductor-to-ground insulation by decreasing surge magnitude, and capacitors protect turn-to-turn insulation by decreasing the rate-of-rise.

Recent improvements in insulating materials used in generators have increased the impulse strength by more than 25 per cent. Therefore, the impulse withstand strength of the ground-wall insulation, listed in Table I, is taken as 1.25 times the crest voltage of the 1-min, 60-cps ASA proof test instead of 1.00 as in earlier practice.

Computes Voltage from Many Factors

The surge voltage between turns is dependent on the surge voltage's rate-of-rise, velocity of propagation, as well as the turns per coil, turn length, and coupling between turns. Large turbine generators invariably have a single turn per coil and therefore no turn insulation. Consequently, no practical limit need be placed on the rate-of-rise. Generators having multiple turns per coil, notably waterwheel generators, may

# of Unit-Connected Generators

be assumed to have turn insulation strength equal to crest line-to-line voltage divided by the number of turns per coil. The maximum permissible voltage rates-of-rise listed in Table I for 2- to 5-turn coils are based on conservative values of these variables.

High-Side Arrester Limits Surge

The lightning arrester on the high-voltage side of the transformer limits line-to-ground voltage to E_A, which is the arrester discharge voltage. This applied E_A is composed of a surge voltage E_1 and the 60-cps voltage $V_P \sin \omega t$. On the low-voltage side of the transformer, the total voltage is composed of a surge voltage E_2 and the 60-cps voltage $V_S \sin (\omega t + \phi)$. The crest magnitude of total voltage at the generator terminals depends upon the point at which the surge appears on the normal 60-cps voltage. For a wye-delta transformer, $\phi = 30$ deg and the maximum voltage crest at the generator terminals is

$$E_S = PNE_A + V_S \sqrt{1 + P^2 - \sqrt{3}\,P} \qquad (1)$$

where

$$P = \frac{E_2}{NE_1} \qquad (2)$$

N = [ratio of line-to-line voltage on low-voltage side to line-to-line voltage on high-voltage side of transformer.

The rate-of-rise of E_2 is

$$\frac{dE_2}{dt} = RN\left[E_A - V_P \frac{\sqrt{3} - 2P}{2\sqrt{1 + P^2 - \sqrt{3}\,P}}\right] \qquad (3)$$

where

$$R = \frac{dE_2/dt}{NE_1}$$

If P and R can be determined, the essential characteristics of voltage at the generator terminals can be calculated from equations 1 and 3.

Surge on 2 Conductors Sets Maximum

The maximum surge voltage at the generator terminals results when surges arrive at the transformer on two of the three phase conductors. In the equivalent circuit, Fig. 2, a lumped capacitor C represents the cable or isolated-phase bus connecting the generator to the transformer. The generator is represented by a resistance equal to the generator's equivalent surge impedance Z_G. This equivalent surge impedance varies with the type and rating of the generator and with the applied wave shape and time. Values from 50 to 200 ohms for single-turn-coil generators have been measured. To give conservative results, desirable when cases are generalized, the generator surge impedance for this study is held constant at 150 ohms.

The inductance L is defined as the transformer leakage inductance referred to the low-voltage side for 2-winding transformers. Three-winding transformers are discussed later. Z_1 is the surge impedance of the line connected to the high-voltage side of the transformer.

The wave shape of applied voltage E_1 is dependent on the arrester characteristics and circuit constants of the connected system. This voltage rises until the arrester sparks over and then changes abruptly to the voltage corresponding to arrester discharge current. Arrester voltage then decreases to zero as the current decays. The important characteristic of the applied voltage surge is the tail or time-to-half value, set at 100 microsec in this study. The discontinuity (or possible spike) resulting from arrester spark over, and the front of the arrester voltage wave have negligible effect on the shape and magnitude of voltage transferred electromagnetically through the transformer.

Crest Magnitude Is Determined

The circuit of Fig. 2, using $Z_G = 150$ ohms and a 0×100 microsec exponential wave shape of E_1 was solved to obtain the crest value and rate-of-rise of E_2 in per unit of NE_1. This was accomplished by writing the equation in terms of the La Place transform variable s and determining the inverse La Place transform by use of a digital computer. L and C were varied over the expected range and the parameter N^2Z_1 was set equal to 7.5 ohms. The rate-of-rise of E_2 is defined as the maximum rate-of-rise occurring on the front of the surge during any 1-microsec interval.

Fig. 3 gives the crest magnitude of E_2 in per unit of NE_1 or, as defined, the value of P. Increasing C or decreasing L results in higher generator surge voltages. The rate-of-rise of surge voltage at the generator terminals is given in Fig. 4, which shows the predominate effect of capacitance at low values of leakage inductance.

Constants P and R determined from Figs. 3 and 4 are used in equations 1 and 3 to determine the magnitude and rate-of-rise of voltage at the generator terminals. These values are then compared to the

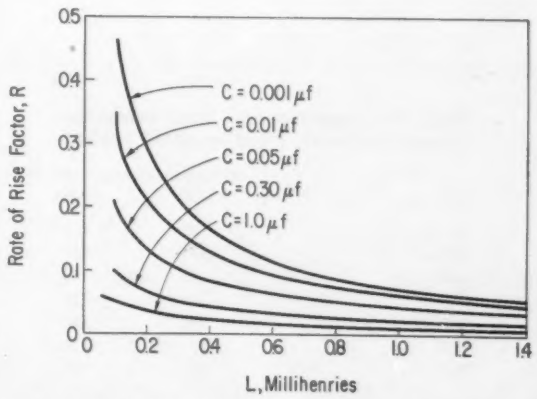


FIG 4. SURGE VOLTAGE RATE-OF-RISE at generator terminals also depends on L and C of the circuit

Table I—Impulse Strength of Ground-Wall Insulation and Maximum Permissible Rate-of-Rise at Generator Terminals

Generator Rating, Kv rms	Impulse Withstand, Kv crest	Max. Permissible Kv per microsec for coils of . . . 1 turn	2 turns	3 turns	4 turns	5 turns
11.0	41		19	12	9	7
11.5	42		20	13	10	8
12.0	44		20	14	10	8
13.8	51		24	16	12	9
14.4	53		25	16	12	10
15.0	55	No	26	17	13	10
15.5	57	Practica	26	18	13	11
16.0	58	Limit	27	18	14	11
16.5	60		28	19	14	11
18	65		31	20	15	12
20	73		34	23	17	14
22	80		37	25	19	15
24	87		41	27	20	16

Table II—Typical Capacitance per Phase of Isolated and Segregated Phase Bus

Rated Amp rms	Micromicrofarads per Ft Isolated 15 Kv	Isolated 23 Kv	Segregated 15 Kv
2000	8.7	7.7	10.2
3000	12.1	10.3	10.2
4000	13.2	11.2	12.6
5000	16.4	13.6	14.9
6000	19.8	16.0	17.1
7000	23.4	18.5	17.1
8000	19.5	16.2	
9000	21.5	17.1	
10000	24.4	20.0	
11000	26.2	21.5	
12000	28.4	23.0	
13000	30.3	24.4	
14000	32.8	26.3	

Table III—Capacitance of Single-Conductor, Concentric-Strand, Paper-Insulated Cables*

MCM	C, Micromicrofarads Per Ft 15 Kv	23 Kv
250	132	102
350	151	117
500	175	135
750	208	159
1000	236	180
1500	281	214
2000	320	243

* Dielectric Constant = 3.7

Examples Apply New

Example 1—A large steam-turbine generator having single-turn coils is connected to a 200-Mva, 230-13.8-kv wye-grounded delta transformer bank by 100 ft of 9,000-amp isolated-phase bus. The transformer has 10% leakage reactance and a 195-kv, station-type lightning arrester on the high-voltage side. Because the generator has single-turn coils, no surge capacitors are required and only the magnitude of the voltage needs to be considered.

From the above information
$N = 0.060$
$L = 0.252$ millihenries
$V_S = 11.3$ kv
$V_P = 188$ kv
$E_A = 555$ kv at 10,000 amp
$C = 0.00215$ microfarads (from Table II)

From Fig. 3, $P = 0.80$ and from equation 1, $E_S = 32.4$ kv. Comparing this value with the 51-kv impulse in Table I indicates that arresters at the generator terminals are not required.

impulse insulation strength and maximum permissible rate-of-rise of surge voltage for the generator to determine if additional arresters and/or capacitors are needed at the generator terminals.

Applies to 3-Winding Transformers

Transformers in some hydro stations have a wye-grounded high-voltage winding and two delta-connected low-voltage windings. The two delta-connected windings are nearly identical, with equal voltage ratings and similar leakage inductances to the high-voltage winding.

The equivalent circuit for such a transformer connection is shown in Fig. 5. Inductances L_1 and L_2 are obtained from the conventional wye-equivalent circuit of the three-winding transformer. The conventional percent-reactance circuit, Fig. 6(A), is obtained on the delta-winding-kva base from the given percent leakage reactances of the three windings. From these, the inductances, Fig. 6 (B), are obtained on the delta-winding-circuit voltage and kva base. N_1 is the ratio of delta-winding line-to-line voltage to wye-winding line-to-line voltage.

Generators connected to the low-voltage delta windings are assumed to have approximately equal surge impedances. The capacitances of cables connected to each of the low-voltage windings would also be approximately equal. The equivalent circuit, Fig 5, is similar to Fig. 2 and Figs. 3 and 4 can be used to obtain P and R for the three-winding transformer by letting

$$L = 2L_1 + L_2 \qquad (5)$$

After determining P and R, equations 1 and 3 can be

Method to Plan Protection of Typical Units

Example 2—Four waterwheel generators having four turns per coil are connected to a three-winding transformer connected wye-grounded on the 230-kv winding and delta on the two 13.8-kv windings. Two generators are connected to each of the 155-Mva delta windings. Each generator is connected to the transformer by four 1,500 MCM, single-conductor, paper-insulated, concentric-strand cables per phase. Cable length is 300 ft. The wye-grounded transformer winding is rated 310 Mva and leakage impedance Z_{HL} between the high-voltage and each of the low-voltage windings is 24% on this base. Leakage impedance Z_{LL} between the low-voltage windings is 58% on the 310-Mva base. Station-type, 195-kv arresters are applied on the high-voltage windings.

From the above information
$N_1 = 0.060$
$V_S = 11.3$ kv
$V_P = 188$ kv

$$X_1 = 1/2\,[24 + 24 - 58]\,\frac{155}{310} = -2.5\%$$

$$X_2 = X_3 = 1/2\,[24 - 24 + 58]\,\frac{155}{310} = 14.5\%$$

$L_1 = -0.0814$ millihenries
$L_2 = L_3 = +0.472$ millihenries
$E_A = 555$ kv at 10,000 amp

From Table III, $C = 2 \times 4 \times 281 \times 300 \times 10^{-6} = 0.675$ microfarads.

The value of inductance L used to enter Figs. 3 and 4 is

$$L = 2L_1 + L_3 = 0.309 \text{ millihenries}$$

Therefore $P = 1.06$ and $R = 0.05$ and, using equations 1 and 3, $E_S = 41.3$ kv and $dE_2/dt = 1.9$ kv per microsecond. Table I shows generator impulse withstand strength as 51 kv and maximum permissible rate-of-rise, 12 kv per microsecond. Therefore, no additional arresters or capacitors are necessary at the generator terminals.

used to determine the maximum crest voltage at the maximum crest voltage at the generator terminals and the rate-of-rise of the surge voltage.

System Parameters Govern

The capacitance C of the isolated-phase bus or cable connecting the generator to the transformer, the line surge impedance Z_1, and the crest magnitude of the arrester discharge voltage E_A must be known to determine the total maximum generator terminal voltage and rate-of-rise of the surge voltage. Approximate capacitance values are given in Tables II and II. An average value of line surge impedance Z_1 is 400 ohms. And the arrester discharge voltage corresponding to a 10,000-amp discharge is recommended for conservative general applications.

For the wye-delta transformer case considered here, voltage at the generator neutral remains zero regardless of the method of grounding the neutral. Therefore, no lightning protection is necessary at the generator neutral.

Arresters, Capacitors Evaluated

If the crest magnitude of voltage at the generator terminals is greater than the impulse withstand strength listed in Table I, arresters should be applied at the terminals. Capacitors should be applied if the rate-of-rise of surge voltage is greater than the maximum permissible rate-of-rise listed in the table. If it is determined that capacitors are required, but not arresters, the crest voltage magnitude should be re-calculated to include the capacitance of the surge capacitors; this increases the crest voltage magnitude and may necessitate arresters.

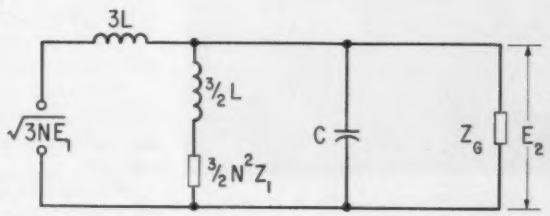


FIG 5. EQUIVALENT CIRCUIT gives surge voltage at generator terminals through a three-winding wye-grounded-delta-delta-connected main transformer bank

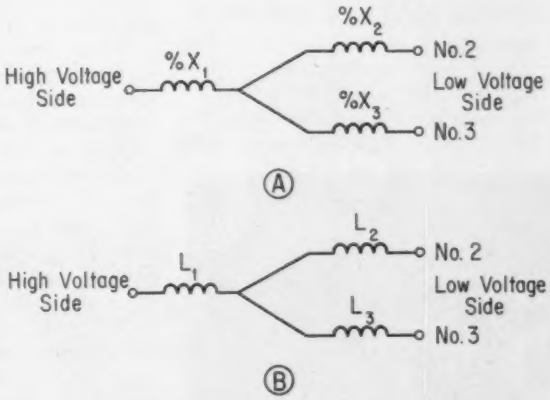
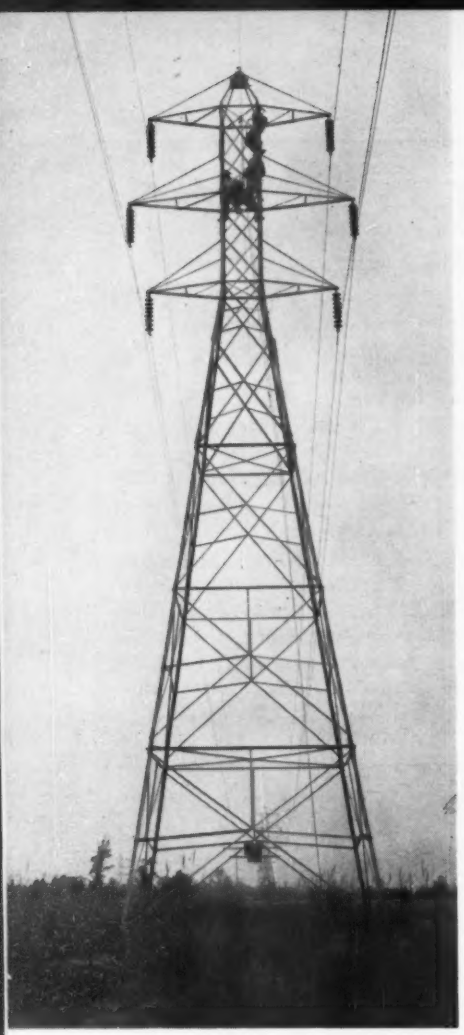


FIG 6. INDUCTANCES used in equivalent circuit are determined from the conventional reactance diagram



ADDITIONAL BRACING is installed in tower cage preparatory to reconductoring. Such reinforcement of towers has generally been limited to more and heavier bracing in upper cage

REINFORCED TOWER FOOTING insures against uplift. Shown is installation of screw anchors and concrete prior to attaching to tower footing. Attachment is made by interlacing reinforcing bars and adding more concrete

Reconductoring Merits

VEPCO finds reconductoring can be economical of time, effort and money during rapid transmission expansion

J. P. COX, JR, Asst. Transmission Engineer, Virginia Electric & Power Co., Richmond, Va.

Virginia Electric & Power Co has found that reconductoring transmission lines, for the most part, has been improperly relegated to a minor role in most overall construction programs. In an era of rapid expansion of transmission facilities, including higher transmission voltages and new line extensions, reconductoring can save time, effort, and money, even though the projects are involved, time-consuming, and costly.

VEPCO's reconductoring program is now in its third year. It has included numerous projects, both large and small, and each of an almost individual nature. All the projects fit these patterns:

- Load growth at major load centers requires heavier lines
- Increases in generating station capacity requires heavier lines to get additional energy away from the stations
- Excessive line losses in older, smaller conductor lines have made replacement economical
- Right-of-way limitations in built-up areas prohibit new lines.

Reconductoring often grows out of line re-arrangement. Old lines with small conductors sometimes end up as part of a larger-conductor line grid and must be reinforced.

Tower line projects are usually all "custom tailored." Each line is different and a different set of basic specifications and rules control the engineering and construction. Safety factors and loading conditions must be clearly defined as there are physical as well as economic limits in reinforcing towers. Often, in the final analysis, the conductor used represents a compromise.

Relatively new wood pole H-frame lines, ten years old or less, have not presented too many problems in the VEPCO program. Such lines usually require some additional guying or bracing, a few crossarm replacements, or reinforcement of angle structures. Most often they have been simple, clean-cut construction jobs. A good example is a recently completed 4-mile section of line exactly ten years old. In replacing the 4/0 copper conductors wtih 636 ACSR, it was necessary to replace only one crossarm on 33 structures. Some additional guying and re-working angle structures was necessary. But a contractor, using basically two oversize crews, completed the job in less than two working weeks.

Old Wood Is Problem

But in reconductoring old wood pole lines, projects often entail considerable structure modernization. VEPCO's experience has been that the cost of reconductoring old wood pole lines is more than double that of reconductoring relatively new ones, with the costs proportional to structure replacements. A good illustration of this is a current 54-mile project between Charlottesville and Remington, Va. Originally built about 1927 with 4/0 ACSR conductors and one Copperweld shield wire, the structures are Western red cedar poles, butt treated, with small steel-angle crossarms. Since 1944, line maintenance, including conversion from 66 kv to 110 kv, and short relocations have resulted in replacement of approximately 40% of the original structures with creosoted yellow-pine poles and crossarms. The remainder of the original structures required replacement to carry the new 636 ACSR conductors. Although designated a reconductoring project, it was actually a major modernization project.

The engineering time and extent of a reconductoring project is usually equal to or greater than that of new work, even though surveying is eliminated or vastly curtailed. This is primarily due to the necessity for engineering calculations for both existing and new structures. One principal controversy usually pertains to the fiber stress value of old wood poles, which will vary

Bigger Role in Transmission

with age, initial specifications, use, and local conditions. Also, preliminary investigation is necessary to ascertain the general condition of the line, and this is usually followed by a climbing inspection to determine the smallest work detail necessary to restore the line to first class condition. Then, too, in reconductoring as for new transmission lines, VEPCO always designs to meet or exceed Grade B requirements of NESC.

Types Are Mixed

The policy is to mix modern standard-type structures, with slightly different phase spacing and improved hardware, with existing structures that are adequate. The greater transverse loading of larger conductors has necessitated reinforcing tangent H-frame structures with side guys and spar cross braces. Side guys are used where soil conditions are not adverse and through wooded areas. Cross braces are generally used for longer spans where rock is encountered and in cultivated fields. On recent large projects the material plus installation costs of cross braces has tended to be less than that of side guying.

Pole Tops Extended

In reworking several old lines that did not have overhead ground wires, VEPCO used two of the existing conductors for this purpose. The two conductors were transferred, without pulling them out and back in to the top of the pole structures. Careful analysis, under various conditions, of the sag of the old conductor was made, and that compared with the new conductor. These comparisons usually work out most satisfactorily.

Pole top extensions are installed on old structures for overhead ground wire so as to match the height of the new structures being added. Also, existing structure poles are stubbed to get additional height and increase structure strength at the ground line.

Tower lines to be reconductored require extensive investigation and engineering, including stress analysis for many different loading conditions. Where loading conditions on existing towers permit two or more broken wires, the loads for reconductoring are accepted as satisfactory with one broken wire. In general, the reinforcement has been limited to heavier bracing in the upper cage. On occasions, however, it has been necessary to pour concrete around footing legs and to improvise mechanical anchors for additional insurance against uplift.

Time Limitations Set

Most reconductoring projects encounter major operating problems in getting lines out of service to do the actual construction. There are usually many complications in the planning stages which have to be resolved before final authorization for the project is granted. Even then in most cases rigid time limits on construction are set, and often the status of construction must always be left so that the line could be made operational very soon.

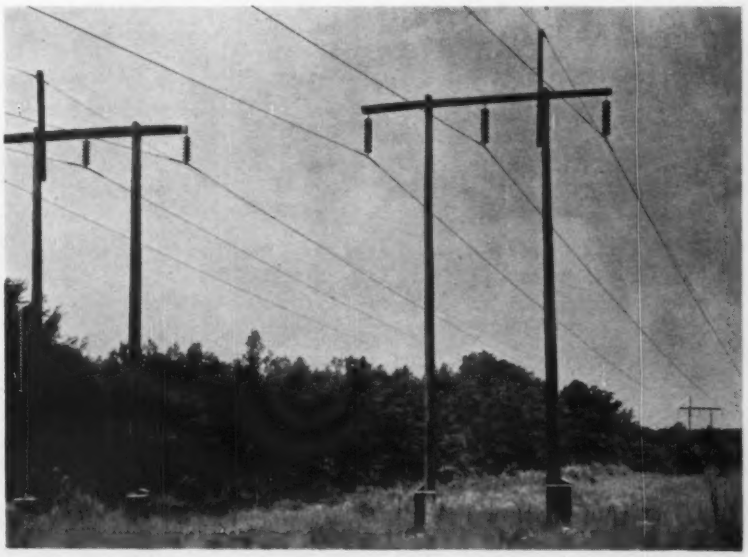
Temporary construction to avoid substation outages should be held to a minimum during reconductoring. A short section of line or bus between two switches where substations or radial taps take off have always presented difficulties. Often old conductor has been left in these sections until a more opportune time when an outage can be arranged. In some instances, however, an improvised bus, switch installation, or some temporary construction is the solution.

The major construction problem is really one of operating—that is, operating requirements have been a large obstacle in bidding and contracting reconductoring projects, often causing construction "crash programs" with sacrifices in economy. Fixed bid contracts require escape clauses for the uncertainties of operating emergencies or when the company makes certain specific requirements during and of the construction processes.

Materials Salvaged

Intermixed types of construction, old and new, on a line have not caused serious hardships in construction. Intermixing does require closer field supervision of the work as well as a more thorough inspection when it is complete.

One basic rule prevails at VEPCO, concerning the materials removed from service on a reconductoring project. It requires that material be salvaged, reconditioned, and re-used where practicable.



RECONDUCTORED LINE has pole top extension for overhead ground wire. Pole stubs give additional ground line strength and clearance

Rugged Sierra Terrain Makes Toil

65-FT POLES, fully dressed, were placed by helicopter, which also strung shot line for pulling in the conductor

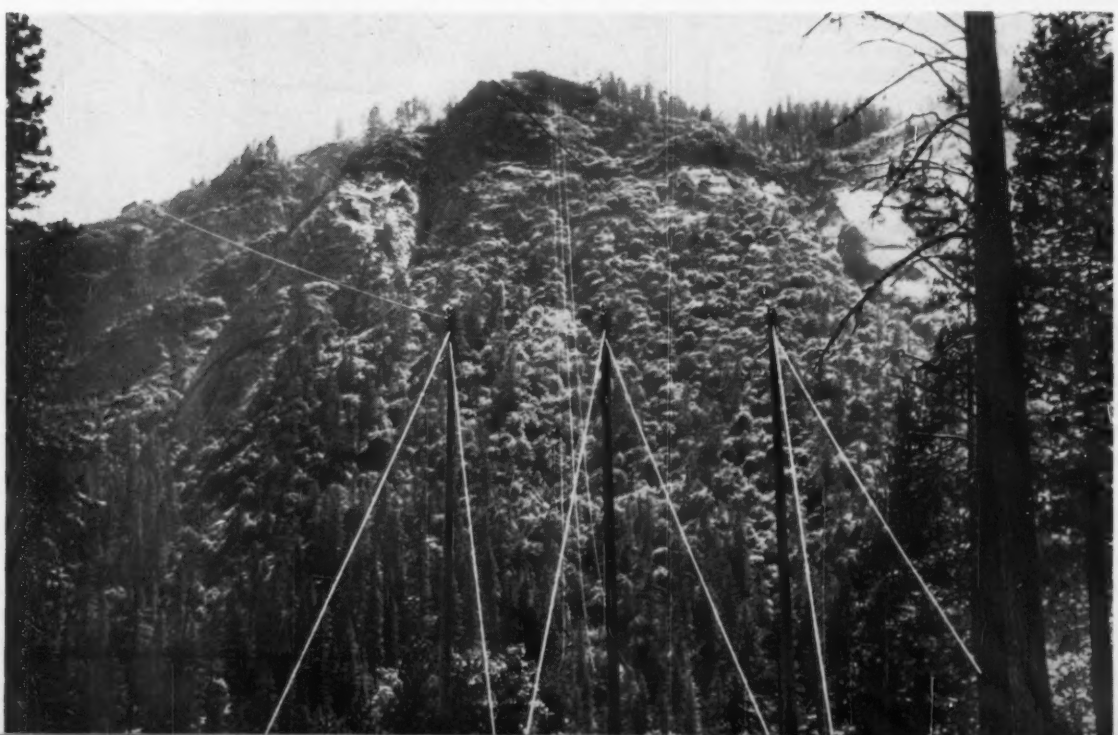
Wide canyons, tight spots and icing pose problems for Mammoth Pool construction service; helicopter sets dressed poles

W. C. THOMPSON, District Superintendent, and
E. J. BRIDGES, Distribution Engineer, Southern California Edison Co, Visalia, Calif.

Providing temporary electric service for a major construction project can be a man-sized job, as Southern California Edison Co found when it undertook the Mammoth Pool Hydroelectric Project. This construction area lies in the high Sierras 65 miles northeast of Fresno, Calif., in rough mountain terrain. Deep canyons, densely wooded slopes and huge granite formations severely handicapped the layout and construction of the 16-mile, 16.5-kv line.

Elevations vary from 2750 ft to 5600 ft along the line which originates at Big Creek Powerhouse No. 8 and terminates near Mammoth Dam. Building through the rugged topography called for nine spans over 1,000 ft long, one of them crossing a canyon 4,400 ft from one dead-end structure to the other. The line is entirely on wood poles and consists of three 336.4-MCM 30/7 ACSR conductors in horizontal configuration supported on 122 single poles, 34 "H" frames and four 3-pole structures.

The line runs parallel to a Forest Service road for the first twelve miles to a summit known as Mile High Point. Following the general course of the road 15 miles farther to the damsite over rugged terrain, however, would have doubled the cost and resulted in greater line loss. So the shorter route was taken across



# of Temporary Line

Shake Flat Canyon, a gorge with steep walls rising to 5800 ft elevation.

The straight line distance across it between the two dead-end structures is 4,400 ft, with a difference in elevation of 1,789 ft. Design called for a sag of 600 ft. Thus each conductor approaches 5,000 ft in length. The three 65-ft wood poles of the upper structure were set on a natural table top. Tight space limited the horizontal distance between them to 15 ft. Each pole is individually guyed and accommodates one conductor. A 50-ft pole braces each dead-end pole against strain caused by the sharp descent of the line into the canyon. Twenty-foot spacing was permitted on the lower structure.

Heavy icing conditions called for ice breakers in each conductor at the low point of sag. Two aluminum reinforced neoprene sections secured with armor rod around each conductor increased the diameter at that point. These breakers protect the dead-end assemblies on the lower structure from damage from sliding ice when the conductors unload.

Most of the 202 poles were set with tractors or line trucks. But a helicopter was used to set 40 poles, complete with crossarms, insulators and guy wires, and to string the shot line for the conductor stringing lines. Each conductor was pulled into position, individually sagged with dynamometer and all three conductors were leveled by transit.

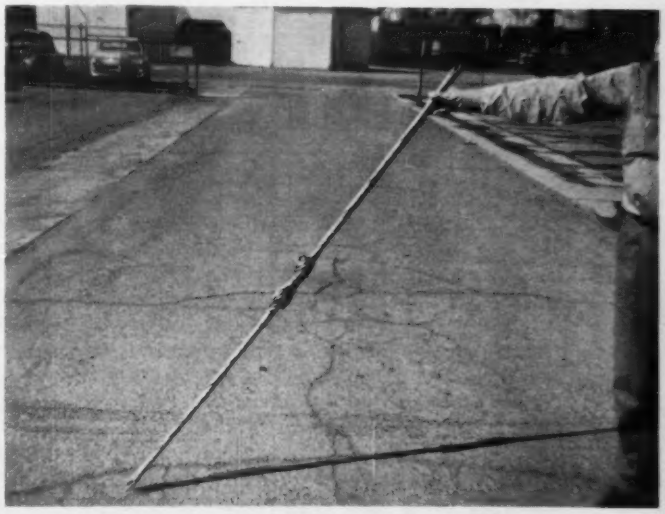
The transformer installations serving construction power and camp facilities range from small single-phase 120/240-v units to platform structures supporting two banks of three 333-kva, 16.5-2.4-kv transformers in parallel. Thirteen platform installations stand at strategic locations among the tunnel, dam, penstock and powerhouse sites. The 16.5-kv distribution voltage was selected because adequate transformation was available at the source to supply this voltage and 16.5 kv is widely used elsewhere on the Southern California Edison system.

Line construction began in February 1958. The previous fall, surveys determined pole and structure locations, hole-digging and line-clearing contracts were awarded, and agreement was reached with the Forest Service regarding disposition of timber. Since the central location of the jobsite is 40 miles from the nearest town, a camp and catering service were established to accommodate the 75 men assigned to construction crews.

The great length of 2,400-v cable used to serve construction of the eight-mile tunnel required five 3-phase regulators to maintain proper voltage for blowers, drills and muckers.

The pole line facilities will remain after construction is complete to serve the area as permanent load develops. Voltage of the distribution line then will be cut over from 16.5 kv to 12 kv.

RUGGED TERRAIN around damsite is viewed from Mile High Point, way station on temporary service line for Mammoth Pool Hydroelectric Project construction



ICE BREAKERS in sag of long span in photo on opposite page prevent damage to lower structure from unloading ice

4,400-FT SPAN saved miles of distribution line. Close quarters kept spacing between poles to 15 ft at the far end

13.8-Kv Line Has High Capacity

Get-away from AEC reactor plant has two 1,590-MCM, all-aluminum conductors per phase for two-way transmission

The 2.8-mile, 13.8-kv get-away circuits from the experimental gas-cooled reactor (EGCR) generating plant, now being developed by the Atomic Energy Commission near Oak Ridge, Tenn., has two 1.590-MCM, all-aluminum conductors per phase. Conductor size has led to facetious reference to the line as a "bus extension."

This line integrates the nuclear station with existing transmission facilities and at times will provide power for starting station motors. Accordingly, the line's high capacity is a design feature for minimizing voltage drop at motor startings as well as line losses once the plant begins generating power. The reactor, it is expected, will be completed late in 1962.

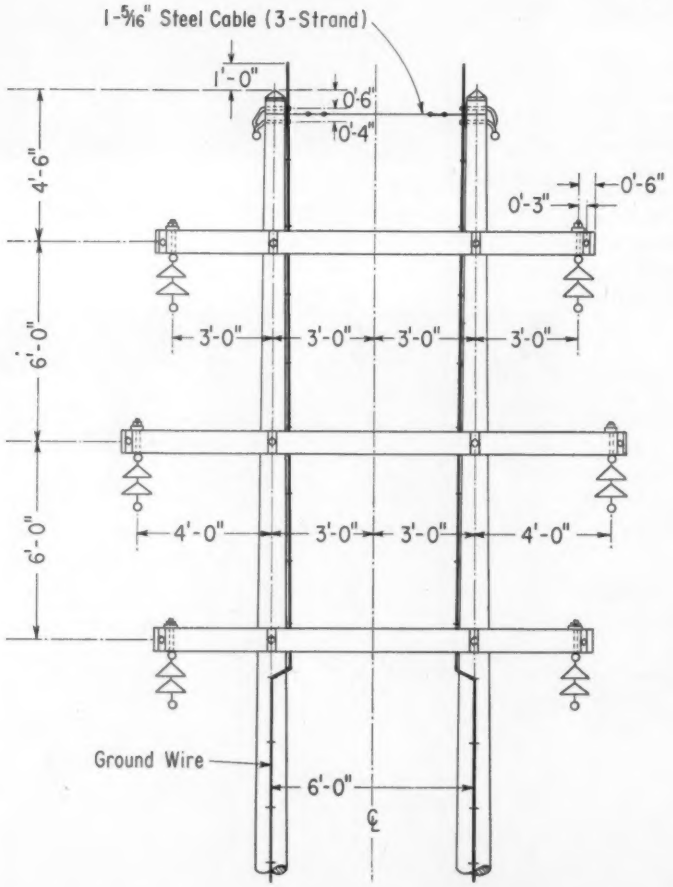
A net load of 23 Mw was used in the design calculations for the line which is intended to operate at a voltage drop of about 5% with a 0.95-pf load. These design criteria dictated the two 1,590-MCM conductors for each phase. The phases are arranged in a vertical configuration on each side of the H-frame structures and are joined at their ends to provide the required capacity.

The line was designed to withstand a transverse loading of 8-lb-per-sq-ft wind on the conductors with ¼-in. radial ice. Structures were placed and guyed so that the fiber stress in the poles under the design loading will not exceed 1,500 psi for angle and dead-end structures and 2,800 psi for transverse loading on tangent structures. The line will also withstand the vertical dead weight of the conductors when the latter carry ½ in. of radial ice. Fiber stress in the crossarms will not exceed 1,500 psi.

The overhead ground wires are two continuous ⅜-in. high-strength steel wires so positioned on the structures as to afford a 30-deg shield angle from the vertical. The structures are double-circuit H-frame type suspension members with two-unit (5¾ by 10-in.) ball-and-socket suspension insulator strings.

The spans permitted use of Class 2 poles, and the crossarms are 6 by 8 in. in section with 13 and 15-ft lengths to provide a 1-ft horizontal separation. The poles are 6 ft apart.

Based on a 400-ft ruling span, the 1,590-MCM aluminum and ⅜-in. H. S. steel cable were sagged so that, under a loading equal to ½-in. ice and an 8-lb-per-sq-ft wind at 0F, a tension of 6,000 lb will develop in the conductor and 2,500 lb in the overhead ground wire cable. Insulator swing clearances give a minimum 10 in. to grounded parts under an assumed load of 4 lb of wind on the bare conductors.



Net Power 22 Mw

The reactor is part of AEC's national effort to develop nuclear power plants that will compete economically with those burning conventional fuels. Its cost, exclusive of research and development, has been estimated at about $30 million. Fueled with slightly enriched uranium dioxide in stainless steel cladding, it will develop 85 tMw and a net power generation of about 22 Mw. Helium will be the coolant.

Steam will be delivered to the turbogenerator at 900F and 1,300 psi, steam conditions exceeding those of any civilian power reactor operating or under construction. The containment vessel, a steel shell, will serve also as the reactor building.

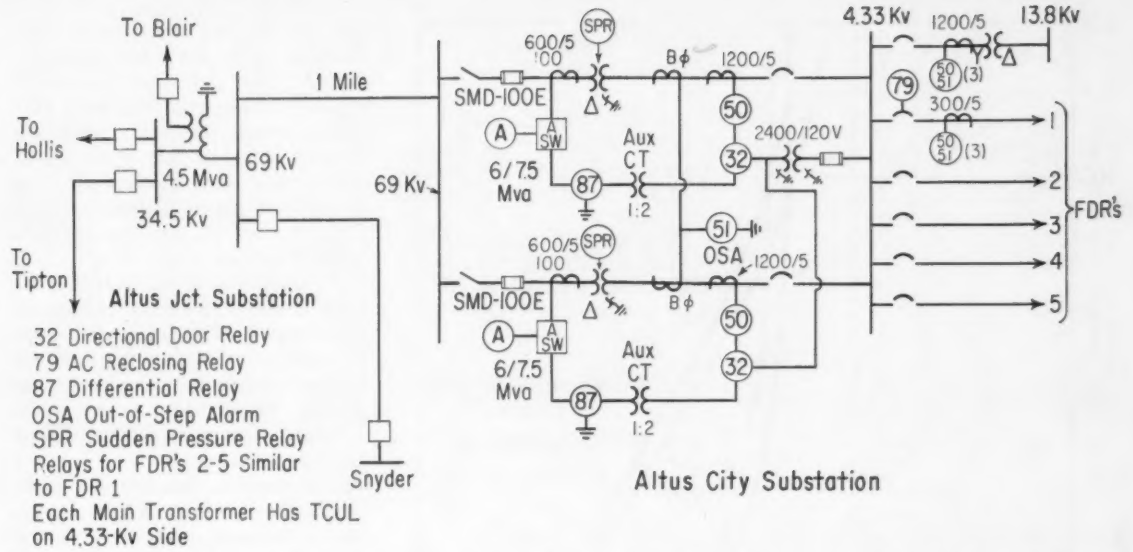


FIG 1. One-mile, 69-kv line linking substations is protected by relay zones of three remote substations. Percentage differential and sudden pressure relays trip low side breaker and sound alarm. Reverse power relays provide back-up

Relay Scheme Saves 69-Kv Breaker

Fuses clear 69-kv line under high voltage faults; relays on high side trip low-side breakers to isolate transformer

R. E. LINTON, C. R. HARVEY, and E. L. GASTINEAU, Engineers, Public Service Co of Oklahoma, Tulsa, Okla.

A unique protective arrangement that obviates high-side 69-kv breakers was developed during recent changes in the municipal substation at Altus City, Oklahoma. Under the scheme, a transformer fault or pressure rise trips the 4-kv breaker on the low side, leaving the transformer to be isolated by 69-v fuses. The 69-kv supply is within the relay zone of breakers at three remote substations.

To serve the rapidly growing municipal substation's load, which now has a 7,800 kw peak, two 6/7.5-Mva fan-cooled load-tap-changing transformers were recently installed. Public Service of Oklahoma supplies this municipal substation and system at wholesale by a one-mile, 69-kv line from the company's Altus Junction Substation. The one-mile 69-kv line between the two substations is in effect part of Altus Junction's 69-kv bus. It is shielded and has not had a fault in over five years. There are no 69-kv breakers on the line but breakers at Snyder, Hollis, and Tipton will clear a fault on it.

Although Altus City Substation had to be protected, a 69-kv breaker could not be justified. Relaying at Snyder and Tipton could not be expected to operate for all faults in the Altus City transformer or to provide back-up for faults on the 4.33-kv bus. These functions are covered by the 100 E fuses on the high side of each transformer bank.

Additional zone protection for the municipal substation has been provided as shown in Fig 1.

• Percentage differential relays (87) around each transformer receive their intelligence from bushing CT's on the transformers' high-side bushings and from wound CT's on the source sides of low-side main breakers. Sudden pressure relays (SPR) guard against turn-to-turn faults. Either of these relay systems will energize an auxiliary relay to trip the low-side breaker for transformer faults and sound an alarm in the home of operating personnel. This does not clear the trouble, but does prevent a defective transformer from trying to carry the load.

Ammeters on the high-side CT's on each phase permit operating men to check current flow with the low side breaker open before clearing the circuit with the 69-kv switch.

• Reverse power relays (32) on the low-side breakers back up the differential relays and provide protection when the differential relays are out of service for test or maintenance. They also protect the bus between the fuses and the high voltage transformer bushings.

• Protection for faults between the fuse and the high voltage bushings is provided by the reverse power relays in conjunction with instantaneous overcurrent fault detector relays on each transformer. The reverse power relay has a 45-deg characteristic. These relays receive intelligence from the PT on the 4.33-kv bus and from wound CT's on the source side of the low-side breakers. This scheme helps isolate trouble and permits the unimpaired transformer to carry load.

These two relays together trip the low-side breaker. But a 4-amp secondary (960 amp primary) setting on the instantaneous relay permits the transformers to be 32 tap positions out of step without being removed. The relay picks up when the transformer load is 7,200 kva.

Out-of-step tap conditions are detected by CT's in B phase on the

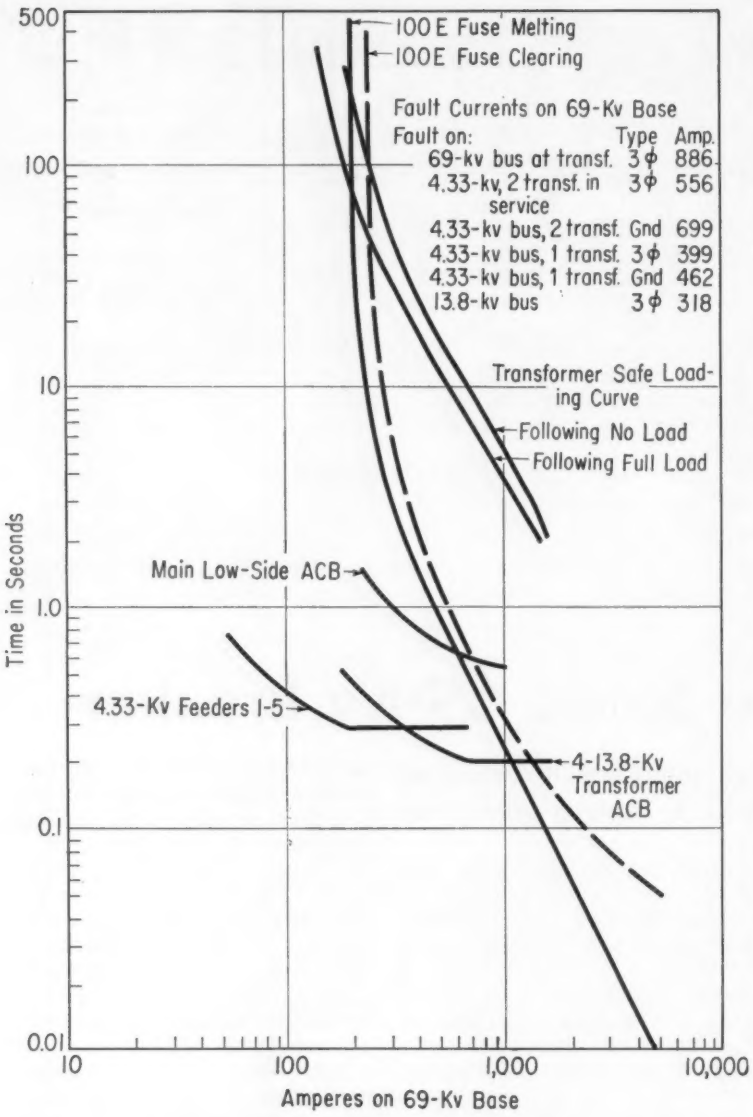


FIG 2. Low-side main 4.33-kv breakers coordinate with all feeder breakers. Back-up for 4.33-kv line is provided by 100 E fuses on transformer high side

low side of each transformer. Secondaries of the CT's are cross-connected. The difference current is applied to an overcurrent relay (51) which sounds an alarm when the transformers are five steps apart. When only one transformer is in service, the alarm feature is inhibited by contacts on the low-side breaker control switch.

•Overcurrent relays also trip the main low-side breakers in case of an overload. The six feeders have overcurrent relays with instantaneous attachments. Three-shot reclosing relays assure automatic reclosing for each feeder. There are no ground relays.

Coordination between the high-side fuse, low-side main breaker, and feeder breakers is shown in Fig 2. Each low-side breaker will coordinate with all the feeder breakers.

Circulating-current calculations for out-of-step conditions were made by two different methods. Results of the calculations were verified by field tests.

The field check was made by leaving one transformer on neutral and raising the other, one step at a time, from position 1 through 16. One position out of step, circulating current was 26.4 amp. Eight positions out of step, it was 226 amp, and 16 positions out of step, 428 amp. Measured values and calculated values differed slightly because bus impedance was omitted. If a 0.1-ohm bus impedance is assumed for the 40 ft of cable between each transformer and its low-side breaker, the calculated value becomes 27.8 amp per step.

Finding Circulating Current for Out-of-Step Conditions

Method One:

$$\%I'_e = \frac{\%e \times 100}{\%IZ + K\%IZ'}$$

Where $\%I'_e$ = Circulating current in percent of full load current

$\%e$ = Voltage difference in percent of normal determined from transformer nameplate (position 1 is 4,357 v and neutral position is 4,330 v)

$\%IZ$ and $\%IZ''$ = Transformer nameplate percent impedance

K = ratio of KVA to KVA''

$$\text{Thus, } \%I'_e = \frac{\left(\frac{4357 - 4330}{4330}\right) \times 100}{7.4 + 1 \times 7.4} = 4.22\%$$

Full load current for a 6,000-kva self-cooled transformer is 800 amp. Therefore, circulating current for one position out-of-step is 800 × 4.22% = 33.7 amp.

Method Two:

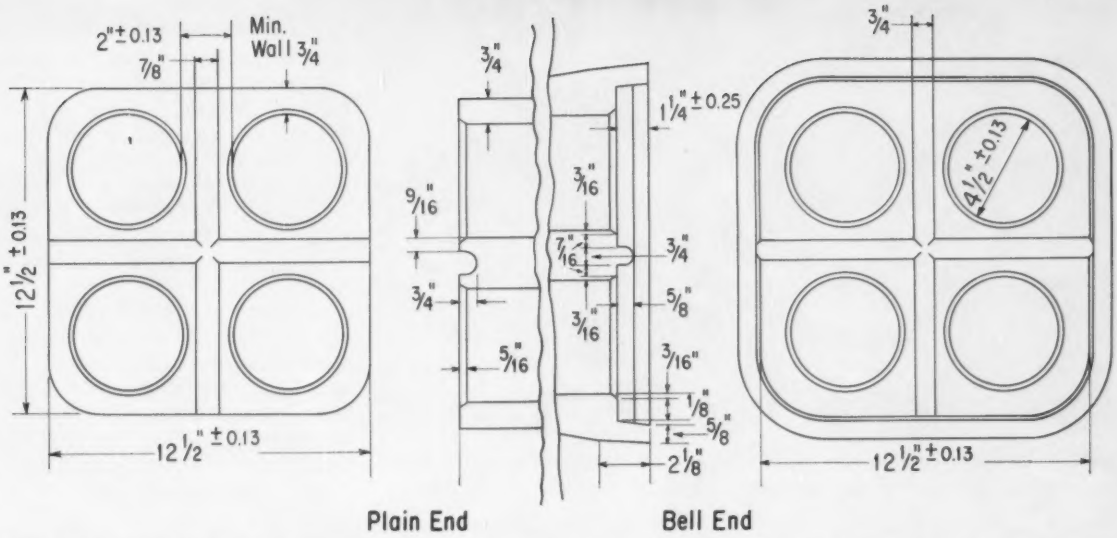
$$\text{Circ. Current} = \frac{E_1 - E_2}{(Z_1 + Z_2)\sqrt{3}}$$

Where E_1 and E_2 = Phase-to-phase secondary open-circuit voltages

Z_1 and Z_2 = Transformer impedances in ohms from the formula $\frac{10 \times \%Z \times KV^2}{KVA}$

= 0.231 ohm at 4.33 kv

$$\text{Thus, Circ. Current} = \frac{4357 - 4330}{(0.231 + 0.231)\sqrt{3}} = 33.8 \text{ amp}$$



DRAWING shows four-duct precast concrete unit which utility developed with manufacturer. Dimensions on drawing are held to very close tolerances, tongue-and-groove shapes being fully formed during manufacture

Precast Duct Underground Saver

Four-duct runs with 4½-in. openings speed installations for Northern States Power, once sealing was developed

THOMAS S. JEPSON, Research Engineer, Northern States Power Co, Minneapolis, Minn.

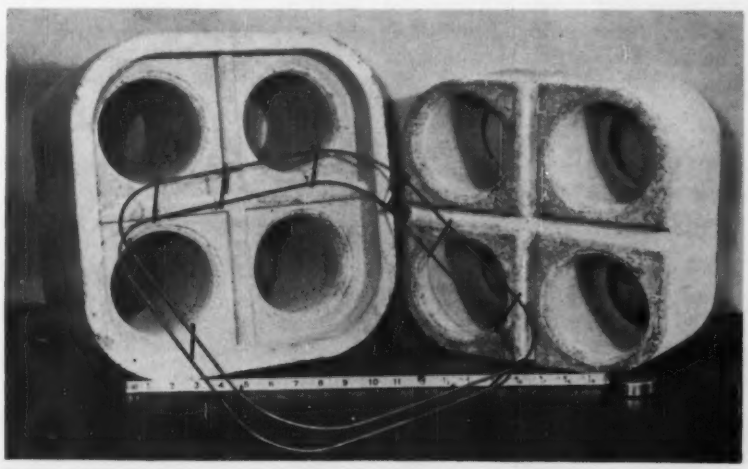
Precast concrete multiple duct for power conductors has been developed by Northern States Power Co in conjunction with duct manufacturers, based on the experience of local telephone companies. Development consisted primarily of increasing the diameter of the duct openings from 3½ to 4½ in. and providing a suitable separation between individual ducts to minimize the effects of faults in adjacent cables. A tongue-and-groove separation is used.

Bell joints between duct units are sealed with a compound made from special bituminous materials and inert fillers. The sealer is applied to the joint by an air-driven caulking gun from 5-gal pails of the compound.

NSP laboratory tests show that the sealing compound is compatible with Neoprene and PVC-type cable jacketing materials, contains no volatiles, and is non-toxic. Thus ventilation and fire-hazard problems are eliminated. It retains flexibility over wide temperature ranges without bleeding or slumping and does not harden. Sealing compounds were carefully investigated because of the company's poor experience with them.

Concrete in duct units is of a quality required by good-practice standards. The plastic mix is placed in a steel mold containing the slightly tapered 4½-in.-dia mandrels which form the duct openings and is vibrated to compact it. This plastic section is then extruded from the mold and placed on platens to be carried to the steam-curing room by fork-lift trucks. When proportioning of ingredients is not closely controlled, the plastic or "fresh" section does not withstand extrusion or the handling to get it to the steam-curing room.

Duct sections are steam cured for 24 hr. Edges of openings are tapered with an abrasive wheel, and a



BELL JOINT, unprimed, was cut from a full length as is done in the field when shorter lengths are needed. Wire bale is the only steel reinforcement employed

SPECIAL HOOK facilitates duct handling. Weight of sections required power handling equipment. Sealer is applied to joint by air-driven caulking gun

honing device is run through each duct opening to assure a smooth interior surface. Ducts are air cured for at least seven days, and a prime coat is sprayed on the bell joint face to insure adhesion of the sealer in wet weather.

NSP specifications require that control specimens from each lot of duct units be supplied to a local testing laboratory to check further the concrete's quality. Moisture absorption, limited to 8% by weight, actually tests well below this percentage.

Alkaline content of water extract from the precast concrete duct and asbestos-cement conduit was compared. Water extracts of asbestos-cement conduit yielded a pH value of 11.7 to 12.1; those of the pre-cast concrete ducts between 10.9 and 11.4. NSP has used asbestos-cement conduit throughout its system and has never had a reported failure of the lead sheath attributable to alkaline attack. No trouble with aged precast concrete is anticipated.

About 19,000 ft of the 4½-in.-dia, 4-way, power-type duct and about 25,000 ft of the 3½-in. dia, 4-way and 6-way, telephone-type duct have been installed. These installations are in open areas and street.

A considerable labor saving over fiber duct incased in concrete is obtainable where one multiple duct unit is installed in the trench. Material costs for both methods are about equal. For two or more multiple units in the same trench, the costs are nearly equal for the two methods.

An important factor is the speed of installation of the precast duct. The laying of a multiple-duct unit and the backfilling proceed as fast as the trenching. They require only enough room between the trenching and backfilling equipment for the duct-laying crew. Street paving can be replaced as soon as the backfill is compacted.

When more than one multiple unit is required in the trench, the practice has been to lay one on top of another with a 4-in. sand bed between and the joints staggered. Placing the sand bed on top of the bottom layer slows up the laying of the top run of units. This trench configuration is preferred because it facilitates adequate offset for contraction and expansion of cables in the manholes.

A four-way, power duct unit weighs about 250 lb and requires mechanical handling equipment. The units are distributed along the trench route by the manufacturer. Breakage in handling has been less than 1%.

After preparation of the trench bottom by raking and bringing to grade, the duct sections are lowered with a special hook which fits into the duct openings. The unit previously installed has had a bead of sealing compound applied with a trowel to the bottom of the bell lip. The unit to be placed is squared up and rammed into position by an iron bar forced into the trench bottom as a level. When a number of units are thus placed, they are lined up to form a straight line. The remaining three sides of the bell joints are caulked with the air-operated caulking gun.

Larger Cables Allowed For

When the duct is to be used soon, a No. 9 iron wire with a hook on the end is pulled into each section as the duct is laid. Experiments showed that an electric duct rodding mouse traverses about 170 ft of duct per min.

Cable pulling crews report that pulling tensions are comparable to those of other types of duct construction, special precautions not being required.

The 4½ in. duct size was selected on the basis that transitions could be made by fitting a 4-in.-dia conduit, such as fiber, iron, or asbestos-cement, into the concrete duct with a minimum of dressing and reaming of the transition conduit. The larger size is desirable also because of the trend to larger underground compound-insulated conductors or aluminum cables.

Only 4-way power duct units are now available. Larger multiples will depend to some extent on whether light-weight concrete can be used in their manufacture. The manufacturer is investigating.

DUCT UNITS are delivered to the job by the manufacturer. Telephone-type duct weighs only 140 lb for four-duct section 3 ft long and is easily installed

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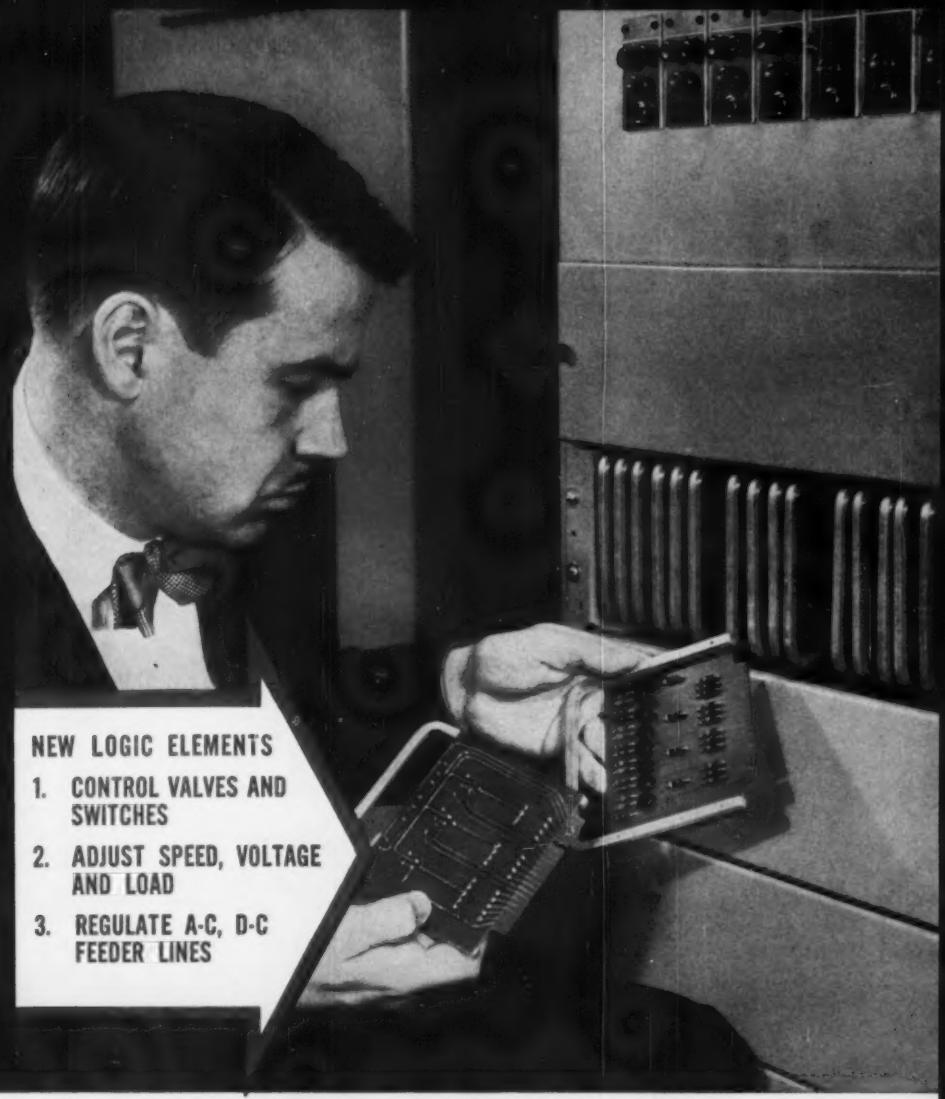

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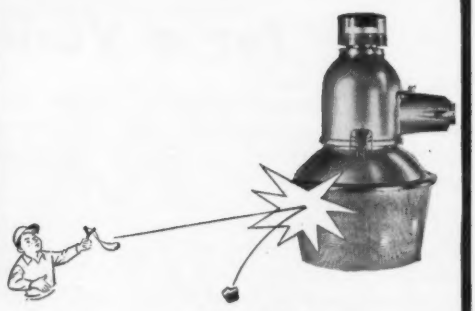

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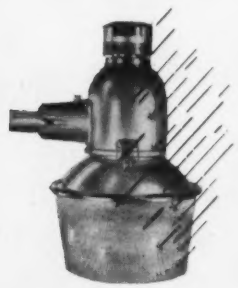

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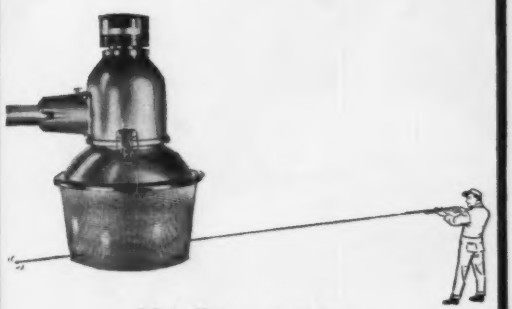

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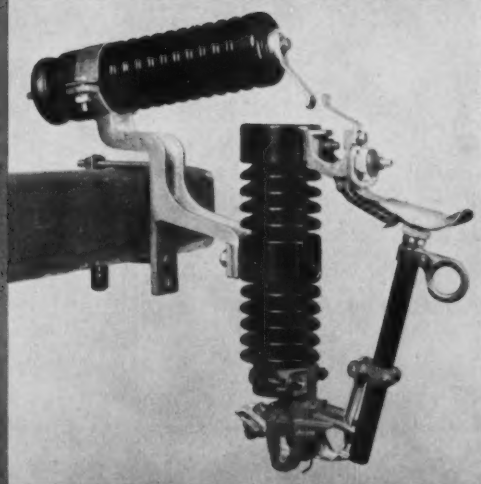
NEW arrester cutout co bination

for pole or crossarm mounting

Now you can get a directly-connected or externally-gapped Magne-valve arrester and open cutout combination that is easier and less costly to install. This new General Electric cutout-arrester combination is available in several standard ratings, for 7200 volt to 15000 volt circuits. It makes a more compact installation on the pole since it takes up less space than the conventional mounting of individual units.

It costs less than separate units, too. You also save in hardware, installation and inventory costs. The unit is packaged and pre-assembled—only two carriage bolts have to be tightened. Brackets for direct-to-pole mounting are also available.

Take advantage of the proved-in-service operating reliability of G-E lightning arresters and cutouts. Ask your General Electric Sales Engineer about the new arrester-cutout combination, or mail the coupon below.



SIMPLIFIED CROSSARM MOUNTING

GENERAL ELECTRIC CO., SECTION A488-05
SCHENECTADY 5, NEW YORK

Please send me the publications I have checked below:

- ☐ Bulletin GEA-4224, "Flip-open Fuse Cutouts"
- ☐ Bulletin GEA-6825, "Oil Cutouts for Fusing and Switching"
- ☐ Bulletin GEA-1816, "Open-dropout Fuse Cutouts with Gas Load Break"
- ☐ Bulletins GEA-6208 and 6245, "Enclosed Cutouts"
- ☐ Bulletin GEA-6379 "Magne-valve Distribution Arrester"
- ☐ Please have G-E Sales Engineer call

NAME _____

COMPANY _____

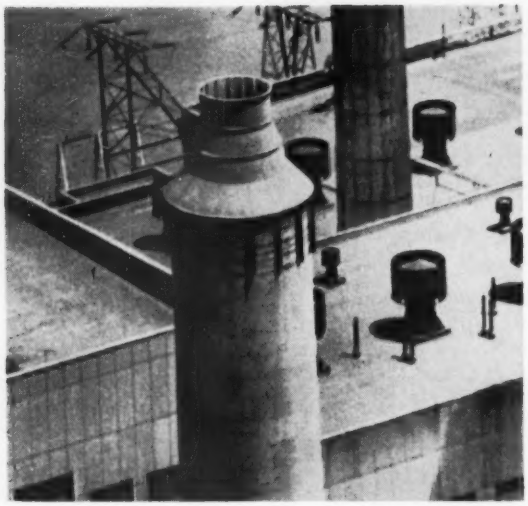
ADDRESS _____

CITY _____ STATE _____

Progress Is Our Most Important Product

GENERAL ELECTRIC

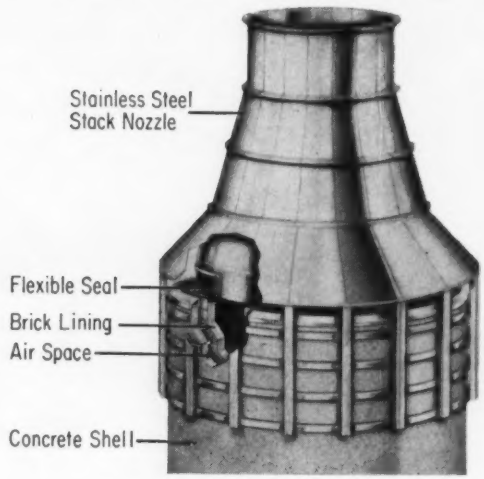
Nozzle Adds 100 Ft to Stack Height



A stainless-steel nozzle attached to the top of a 214-ft stack increased the flue gas velocity and thus added 100 ft of effective stack height. This modification was made to improve the operation of the Seward Generating Station of Pennsylvania Electric Co. Use of the nozzle was prompted by the time—a normal shutdown of three weeks—available for the work and the fact that a 100-ft extension would make the stack much more vulnerable in high winds.

Design of the nozzle was complicated by the dual brick-concrete construction of the stack. The 19-ft OD outer concrete shell is separated from the brick lining by a 6-in. air space to allow the shell to sway under wind load. To attach the nozzle to the brick liner without obstructing the 6-in. sway-clearance space, a double shell skirt was devised.

The inner skirt was attached to the liner with a flexible diaphragm woven from Teflon TFE-fluorocarbon fiber impregnated with Vitron synthetic rubber. The fiber and rubber both are made by E. I. DuPont de Nemours & Co. The outer skirt was fastened to external supports on the concrete stack. Thus, the 10-ton weight of the nozzle is cantilevered from the loadbearing concrete shell and its inner surface is mated to the brick liner. The nozzle was prefabricated by Aerotec Industries, Inc. With the nozzle in place, an additional fan pressure of only 2 in. wg projects 485,000 cfm of gas 100 ft or more above the stack top.



Rig Simplifies Bushing Removal

The maintenance crew of the Power Division of New Orleans Public Service has greatly simplified the method of removing large transformer bushings for inspection and repair. A simplified hoisting rig does the trick.

Formerly, a mobile crane was used to handle these bushings, because they are quite heavy. Now, the hoisting rig is used.

The rig consists principally of a steel pipe bent into a "gooseneck" and made to fit into one end of a longer pipe. When erected, the longer pipe carrying the gooseneck is anchored to the top of the transformer. The gooseneck can rotate 360 degrees. The whole assembly is fitted with eyes for slings and tackle. Welded braces and guy rods give strength and support to the hoisting rig.

ANOTHER STEP AHEAD IN VOLTAGE REGULATION

NEW Permalex Insulation

Permalex* coil insulation in General Electric voltage regulators boosts reliability—lengthens regulator life

New Permalex insulation—another regulator first from General Electric—is now standard on all G-E ML-32 single-phase, step voltage regulators. Permalex makes possible added regulator economies through longer core and coil life and greater reliability—at no price premium.

Permalex insulation preserves high dielectric strength because of the special cyanoethylation of its kraft insulation paper. This process, exclusive with General Electric, retards formation of moisture released by cellulose materials under load—slows aging process of insulation to give you longer regulator life. Permalex insulation is fully compatible with other regulator components and provides a true *system* approach to regulator design.

Another outstanding G-E regulator feature which increases quality, Permalex insulation gives you more regulator for your money. It is, in fact, another reason why *G-E regulators cost less on the line.*

Ask your General Electric regulator representative for more information about Permalex-insulated ML-32 regulators—as well as the entire line of G-E voltage regulators. Or, write to Section 456-03, General Electric Company, Schenectady 5, N. Y.

*Trade-mark of General Electric Company

Progress Is Our Most Important Product

GENERAL ELECTRIC

MARKETS ▶ **New orders for office machinery will rise** through the year—peaking in the last quarter. That is one of the findings of McGraw-Hill Dept of Economics' latest Machinery New Orders Forecast. The latest Forecast shows that capital goods producers have raised their sights on the dollar volume of new business expected this year. They now anticipate a gain of 8% over 1959. In a survey taken three months earlier, they had predicted a gain of only 3%.

The rise in new business is expected to continue through the third quarter and taper off slightly in the fourth quarter. Only the makers of metalworking machinery and office equipment foresee a peak of new orders in the fourth quarter of the year.

PRICES ▶ **Price is held on power capacitors,** but raised 5% to 10% on other types of capacitors made by the Cornell Dubilier Div of Federal Pacific Electric Co. ". . . Technological advances have reduced costs," said Octave Blake, who heads Cornell-Dubilier, "but not sufficiently to offset inflationary increases which have squeezed profit margins to the point where price relief is now mandatory."

FLEETS ▶ **What accessories are being used on automobiles in your fleet?** This question was put to procurement people in 27 electric and gas utilities by a subcommittee of the American Gas Association's Operating Section.

The average utility car has about 6.8 accessories, but there is a wide variation of practices among utilities. One utility lists a rear view mirror as its one and only standard accessory. At the other extreme, a utility lists 13 items as standard accessories for its fleet cars.

Relative acceptance of accessories for standard fleet cars, as shown by the survey of 27 utilities, is: outside rear view mirror 89%; air filter 85%; oil filter 81%; arm rests 78%; windshield washers 63%; cigarette lighters 44%; snow tires 44%; seat covers 41%; automatic transmission 37%; four door sedans 30%; spotlight 18%; no slip differential 15%; deluxe steering wheel 15%; safety belts 11%; tinted windows 7%; back-up lights 7%; standard band radio 4%; eight-cylinder engine 4%; and safety padded dash 4%.

The questionnaire sent out in the survey emphasized, "This report is intended to determine what equipment you would order installed on a standard fleet car if you were ordering one—right now! We are not concerned with the larger, deluxe-type automobiles sometimes supplied top management . . ."

SALESMEN ▶ **New officers of the Electrical Equipment Representatives Assn** elected at the annual meeting in Dallas May 20 are: president—Conrad R. Bangh, Omaha, Neb.; exec vice president—Oliver B. Lyman, San Francisco, Calif.; second vice president—Curtis H. Stout, Little Rock, Ark.; treasurer—H. Jack Belcher, Jacksonville, Fla.; secretary—T. M. Salisbury, Jackson, Miss.

When the heat's on...

ROEBLING TELLURIUM LEAD ALLOY SHEATH IS STEADY AND STABLE!

Wiping operations raise sheath temperatures up to 400° F. Stable sheath is what you need when the heat's on! And Roebling's Tellurium Lead Alloy Sheath retains its remarkable creep resistance and bending fatigue resistance under intense heat, and after it.

What's more, there's extra life built into the carefully made paper power cable *inside*. That's why there's simply no better cable buy when it comes to long life, dependable service, minimum maintenance.

Interesting test and other data are now available. Write today for your free copy of the booklet that shows the way to reduced cable and maintenance costs. Electrical Wire, John A. Roebling's Sons Division, Trenton 2, New Jersey.

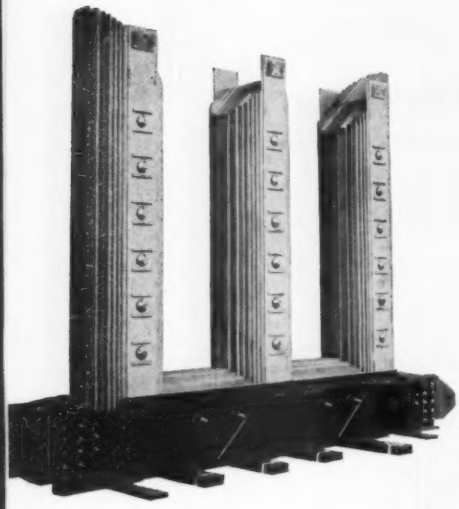
ROEBLING

Branch Offices in Principal Cities
John A. Roebling's Sons Division, The Colorado Fuel and Iron Corporation

Roebling electrical wires and cables are available with either copper or aluminum conductors.

Moloney Uses New Steel to Cut Sound Level

A significant reduction in sound energy generated within power transformers has been achieved by Moloney Electric Co by means of an improved core design using a special steel with unusually low magnetostriction characteristics. Core (below) is for a 37,500-kva unit.



The improved design is an outgrowth of a development program aimed at reducing the sound energy generated in the transformer, rather than attempting to suppress the sound energy after it is produced.

In making the announcement, M. B. Mallett, vice president, said the key to the new core is a special steel "Silectcor" which was developed and made available by Allegheny Ludlum Steel Corp in response to a request by Moloney. This special steel is stress-free, exceptionally flat, and, in addition to its low magnetostriction characteristics, has a basic watt loss and permeability which remain the same as those found in conventionally-oriented steel.

Mallett pointed out that, other factors being the same, average reductions of approximately 8 db in sound level are consistently attainable as a direct result of the application of Silectcor steel to the largest sizes of power transformers. The reduction graduates down to approximately 4 db for the smallest sizes, it was stated. These sound levels are attainable for a reasonable manufacturing cost increase and without increasing weight, dimensions, or complexity of the transformer, it was explained.

To date, the special steel has been successfully applied to 145 power and network transformers ranging in capacity from 500 kva to 217,000 kva, Mallett said. He added that Moloney plans to increase steadily the application of the steel to its transformer production.

New design and manufacturing techniques have been developed by Moloney as required to apply the special core steel to transformers on a production basis. Without these new techniques, Mallett said, the superior qualities of the special steel would not be reflected in core performance.

Cores built with this material are described by the manufacturer as remarkably straight, a condition which minimizes clamping stress concentrations and leads to side benefits of reduced core loss and exciting current.

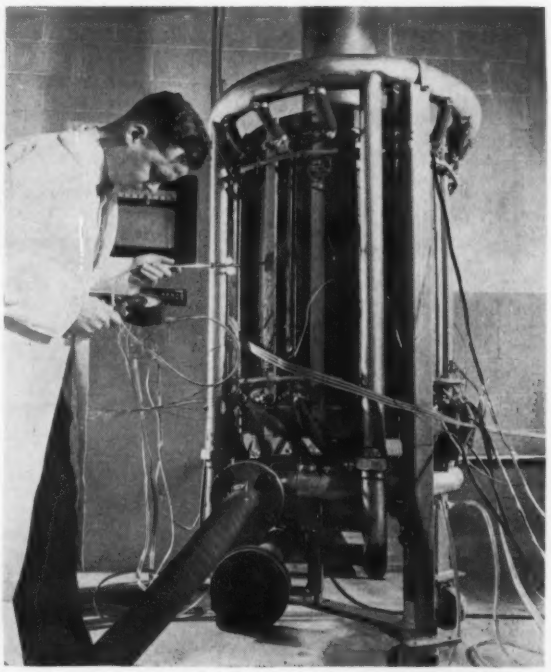
Westinghouse Develops 5-Kw Thermoelectric Generator

Westinghouse has announced successful development of "the most powerful thermoelectric generator ever built," consisting of two 2500-w sub-generators like this (right). Built for the Bureau of Ships, US Navy, it is intended as an experimental unit for evaluation of power generating materials and techniques produced under a Navy-sponsored thermoelectric research program. The generator delivers 5 kw electric power by direct conversion of heat into electricity.

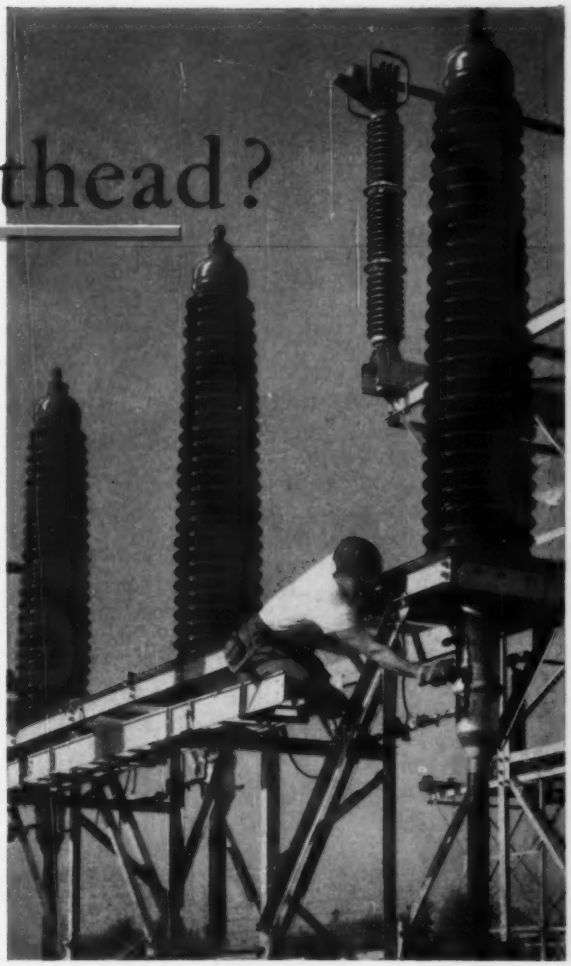
Fired by kerosene, the generator operates at a temperature of 1,200F. Use of a modular type of construction provides a wide variety of output voltages and currents. These combinations range from 10 v at 500 amp to 120 v at about 42 amp. The identical sub-generators can be connected together to give full power output, or used independently of one another.

The only moving parts in the entire 5-kv unit are those in the pumps for cooling water and for kerosene fuel burners. Both pumps are operated by motors receiving power from the generator's electrical output.

(*More News of Manufacturers, page* 70)



What Is A Pothead?



Terminating a metallic sheathed or shielded cable creates an abrupt discontinuity in electrical characteristics of the cable. Electrostatic stresses that have been resolved by optimum balance of dielectric components within run of the cable itself are disturbed at a cable end when sheath and/or shielding are stripped away from the conductor insulation.

Rubber and plastic insulations exposed to the elements are subject to deterioration caused by sun, rain, industrial fumes, salt spray, and the like. Oil-impregnated paper insulation absorbs moisture readily, and if exposed to the atmosphere would soon cease to be an insulator. Creepage distance along the surface of insulation from bare conductor to ground becomes significant and can result in tracking and eventual flashover.

All these conditions are overcome by a pothead to the degree required by system design and BIL level desired. A pothead provides:

1. An hermetic seal of the cable end to prevent contamination of cable insulation by moisture or liquid dielectrics used in equipment to which the cables are connected.

2. An impervious porcelain insulator to protect cable insulation against weather and adverse contaminating atmospheric conditions.

3. Physical protection and mechanical support of the cable conductors, insulation sheath, armor, and so forth.

4. Means for making external electric connections with the cable conductors within the pothead housing.

5. A compact, economical housing providing adequate dielectric strength (including that of the cable end) considerably greater than can be accomplished by any other means within the same space.

Unlike a bushing, where characteristics are controlled by complete factory assembly and test of the whole device, the pothead manufacturer can provide in finished form only a portion of the whole termination. With a pothead termination, the cable, stress-relief cone, and dielectric compound must be assembled with the basic pothead in the field at time of installation. Successful operation of the termination requires proper combination of all these components.

Years of development work and of operating experience have resulted in a thorough understanding by G&W engineers of electrical and mechanical requirements for pothead terminations. From this has evolved the most complete line of pre-engineered standard potheads with improved gasket materials, superior porcelain designs, hermetically-tight metal-to-porcelain bonds, and an array of interchangeable pothead entrance fittings.

G&W knowledge of pothead-design fundamentals, use of materials of the highest grade, flexibility of component parts, and good installation techniques will help you make better cable terminations for more reliable transmission of electric power with underground cables.

G&W representatives welcome the opportunity to consult with you on your present and future cable-termination requirements. G&W's unique engineering service is available without obligation.

G&W ELECTRIC SPECIALTY COMPANY

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CANADIAN MFG. • POWERLITE DEVICES LTD. • TORONTO, MONTREAL & VANCOUVER

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*Trademark

"Superforms* help me insure Uninterrupted Service" ...TRANSMISSION ENGINEER

"Superforms help me accomplish my Number One Job Function:

"*Keeping millions of dollars worth of equipment in constant service for many thousands of customers.*"

Transmission Engineers not only must know the requirements for their lines . . . they must also see that they are met. And, they have found that Fanner Superformed products are always reliable. A-1598A

FANNER Superformed with a "PROTECTIVE TWIST"

ARMOR RODS . . . Protect long-span T&D lines at supports

LINEGUARDS . . . Protect short-span T&D lines at supports

PATCH RODS . . . Repair damaged conductors

TAP ARMOR . . . Protects conductor at tapping points

FANNGRIPS . . . For dead-ending strands and conductors

FANNSPLICES . . . Join two ends of conductor wire

PLASTIC PRODUCTS . . . For conductor surface protection

FANNER
The Fanner Manufacturing Co.
Brookside Park—Cleveland 9, Ohio
Division of Textron, Inc.

General Electric Announces New Control Equipment

General Electric announces development of new solid-state supervisory equipment which uses modern transistors coupled with GE's present space-code type of operational system. To date, two utility company orders have been received: one for control application in a power generating station; the other for control of substations. Western Massachusetts Electric will use one installation and Colorado Central Power the other.

The new equipment is suitable for remote indicating, telemetering and control of any apparatus which has provision for local control.

Easy accessibility of solid-state logic elements (right) is demonstrated by A. R. Christman, GE specialist, product planning. He is holding one of the plug-in cards.

GE feels that this new supervisory equipment will increase the utility of supervisory control, making it easier to operate and maintain because there are no moving parts on the logic elements.

GE design engineers fed data into the computers to obtain a correlation which expedited the design of circuitry for the new, solid-state equipment. Completed shipments will be fully tested at the company's medium voltage switchgear plant in Philadelphia prior to delivery for a given application. With no moving parts, there are no adjustments to be made in the field.

'Self-Starter' Reactor Control Built

Minneapolis-Honeywell Regulator Co has developed a pushbutton control system with automatic start-up which "takes human error" out of nuclear reactor operation. It will be used on the Atomic Energy Commission's plutonium recycle test reactor (PRTR) being built at Hanford, Wash. The system, says Honeywell, can be adapted to any type of reactor.

The PRTR uses a moderator level instead of control rods to regulate the rate of fission. It has a rating of 70 Mw, but lacks generating facilities. The system also measures thermal power with a Btu calculator and uses this as the primary controlled variable. This makes the system independent of the relation between power and ion chamber signal.

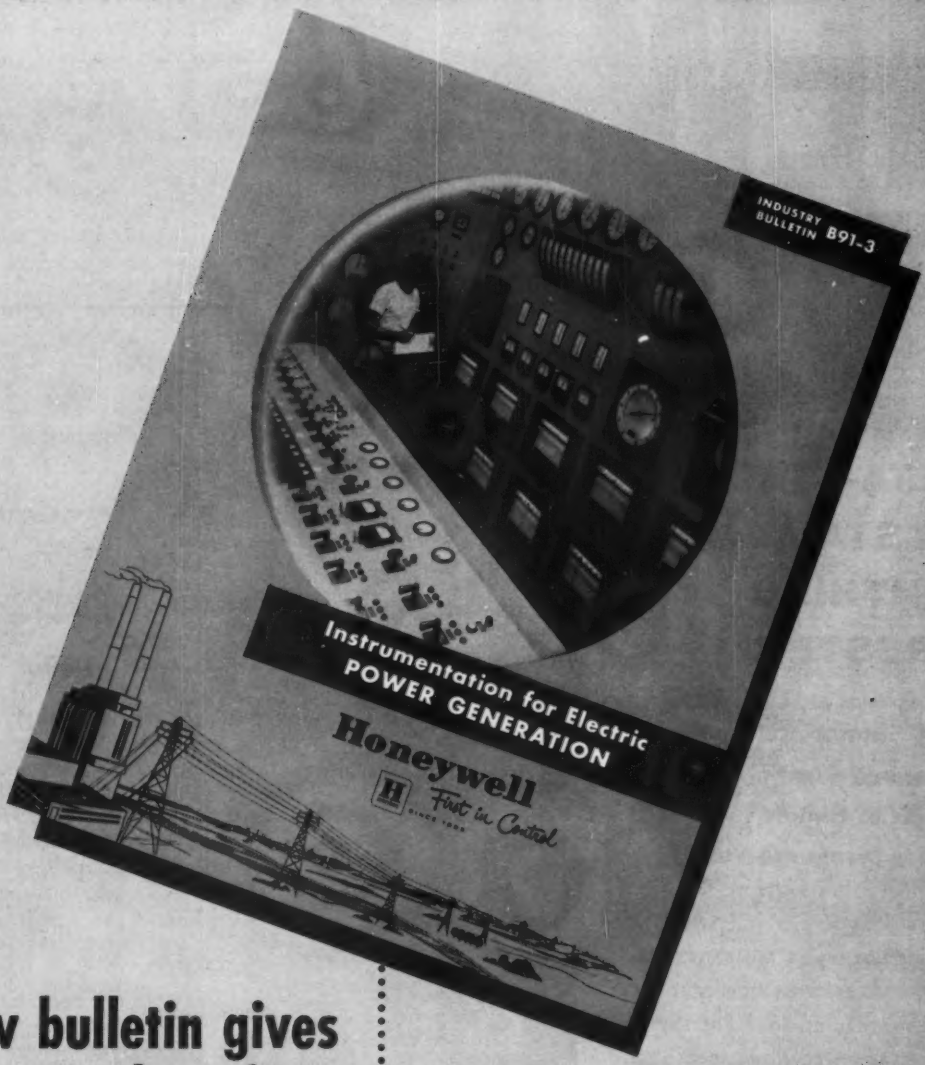
Unlike many reactors which can be started manually and then put under automatic control, the reactor requires rapid start-up.

MANUFACTURERS BRIEFS

Leeds & Northrup will soon ship $170,000 of load-frequency control equipment for New York State Power Authority's Niagara power project . . . A $66,995 order for temperature recording instruments for the same project has been received by **Daystrom, Inc's Weston Instruments Div.** Design of new scanning units included in the contract will permit addition of banks of recording points as required. Both the L&N and Weston orders cover equipment for both the 2,000-Mw Niagara generating station and the Tuscarora power station, a combined pumping-generating plant.

J. A. Weaver Co, St. Louis manufacturer of electrical fittings, has started construction of a new foundry which will more than

(*Continued on page* 72)



New bulletin gives you complete data on power plant instrumentation!

You'll find this new 64-page catalog jam-packed with valuable instrumentation data. It covers all types of controls for boilers, turbines, engines and generators in central stations. It includes basic circuit diagrams and informative descriptions of a variety of specific applications. Detailed specifications are included as a handy guide to selecting recorders for volts, amperes, watts, vars, frequency, time deviation, temperature, pressure, flow and level.

Write today for your copy of Catalog B91-3. It's yours without cost or obligation.

MINNEAPOLIS - HONEYWELL

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75th YEAR PIONEERING THE FUTURE

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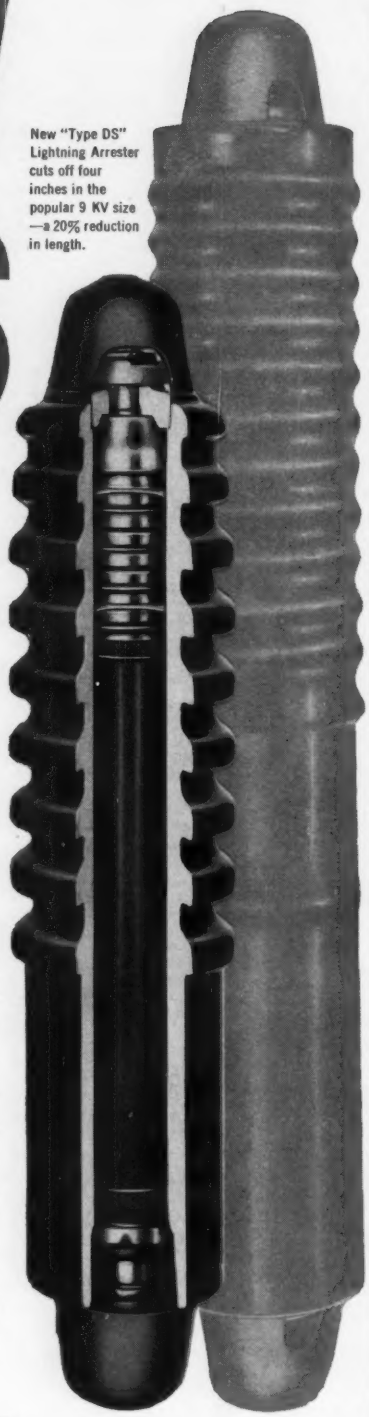
First in Control

H HONEYWELL SINCE 1885

NEW DS

DELTA-STAR CRYSTAL VALVE LIGHTNING ARRESTER



New "Type DS" Lightning Arrester cuts off four inches in the popular 9 KV size —a 20% reduction in length.

- **20% Shorter**
- **Balanced Design**
- **Easier to Handle**
- **Lower Discharge Voltages**

The new "Type DS" Crystal Valve Lightning Arresters are shorter and lighter, for easier handling and installation. Size and weight savings have been achieved while keeping the "Balanced Design" which has made Delta-Star Crystal Valve Arresters top performers for thirty-five years.

For complete information on the new, easier-to-install "Type DS" Crystal Valve Lightning Arresters, write to *Delta-Star Electric Division, H. K. Porter Company, Inc., 2437 W. Fulton St., Chicago 12, Illinois.*

DELTA-STAR PORTER **ELECTRIC DIVISION**

H. K. PORTER COMPANY, INC.

PORTER SERVES INDUSTRY with steel, rubber and friction products, asbestos textiles, high voltage electrical equipment, electrical wire and cable, wiring systems, motors, fans, blowers, specialty alloys, paints, refractories, tools, forgings and pipe fittings, roll formings and stampings, wire rope and strand.

More Manufacturers Briefs

(*Continued from page* 70)

double present production capacity. New production machinery just ordered "will make it the most fully-automated non-ferrous foundry in the midwest," says Weaver. The new building will include a complete laboratory.

Kraloy Plastic Pipe has opened new general offices and manufacturing facilities in Santa Ana, Calif., and a new district office and warehouse in Dallas, Texas. The Santa Ana plant will produce plastic extrusion, Polyvinyl chloride pipe and electrical conduit.

Line Material becomes sole distributor of all **Hughes Bros'** cataloged items, through a distributor agreement reached between the two companies . . . Stockholders of **Control Data Corp,** Minneapolis computer manufacturer, and of **Control Corp,** Minneapolis pipeline controls producer, have approved a merger.

General Electric's communication products department has established a new method of disseminating service information for technicians maintaining mobile radio equipment, called "Datafile." Designed, says GE, to save hours of work time, it contains up-to-the-minute information on latest servicing trends in the industry, also provides a place to file supplementary data. Servicemen can take out folders and place them in their cars. Present subscribers to GE's technical manual program will receive Datafile for two years without fee.

Allis-Chalmers announces the Swedish R-2 30-Mw reactor near Stockholm went critical on May 4. Moderated and cooled by light water, it is capable of producing fluxes in excess of 2×10^{14} neutrons per sq cm sec. The reactor's experimental facilities were designed by A-C for simultaneous irradiation programs in metallurgy, chemistry and physics . . . **Thomas & Betts,** in first public annual report to stockholders, lists net 1959 income of $2,616,743 (71% increase over 1958) on $21,594,091 in sales (26% increase over 1958) . . . **Precision Transformer** breaks ground for 50,000-sq-ft plant at Elk Grove Village, Ill, which will double production capacity.

(*More Procurement & Products, p* 74)

YOUR POWER SYSTEM IS IN THE BEST OF HANDS

First the EBASCO engineer puts his finger on the problem . . . then his hands, his mind, his imagination and ingenuity go to work formulating a solution grounded in the practical, accumulated experience of EBASCO's half-century of working with the electric utility industry.

These hands are familiar with the problems, the possibilities, the capacities of a system's distribution and transmission. Countless times they have worked out the answer to a problem of production . . . of operation, or maintenance . . . of construction or of planned expansion. They have contributed new efficiency to systems which have resulted in lower cost of production.

Where is *your* system problem? In maintenance? In expansion? Do your future needs require a new site, new construction, new ideas? What of the latest equipment, of methods, of streamlined operation?

In the hands of EBASCO, are held the keys that can unlock the answers.

Our brochures describe EBASCO's services and how they may be of use to you. For copies, write Ebasco Services Incorporated, Dept. M, Two Rector Street, New York 6, N. Y.

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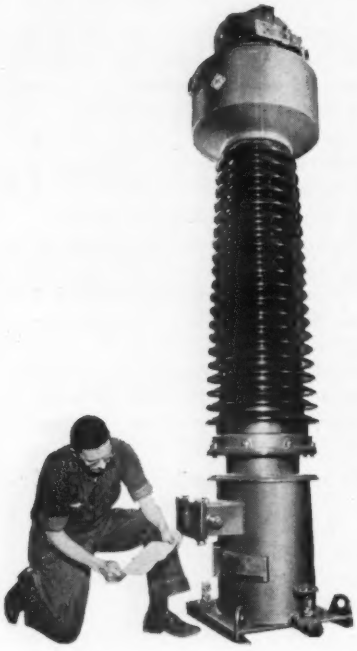
(For further information refer to Readers Service on page 76)

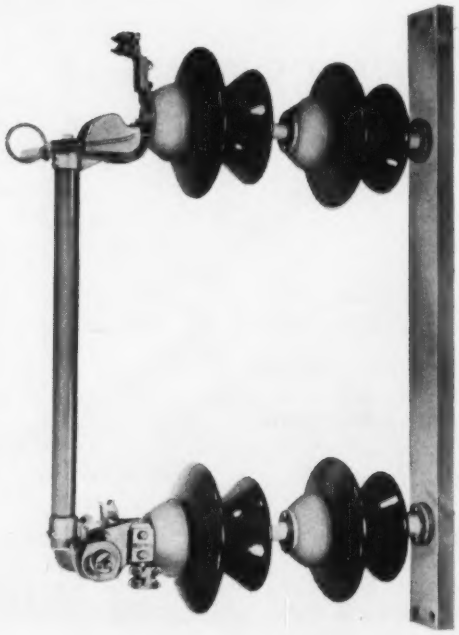
Power Recloser . . .

. . . for 4.8 to 14.4-kv circuits has been redesigned with a series-trip timer that can be adjusted from the control compartment and without deenergizing the recloser. Number of reclosures and number of instantaneous reclosures are also adjustable at the control panel. Characteristic curve of the type PR 3-phase recloser coordinates with those of fuses and extremely inverse relays. Parts for ground fault tripping are available.
Westinghouse Electric Corp, Box 2099, Pittsburgh, Pa.



Current Transformer . . .

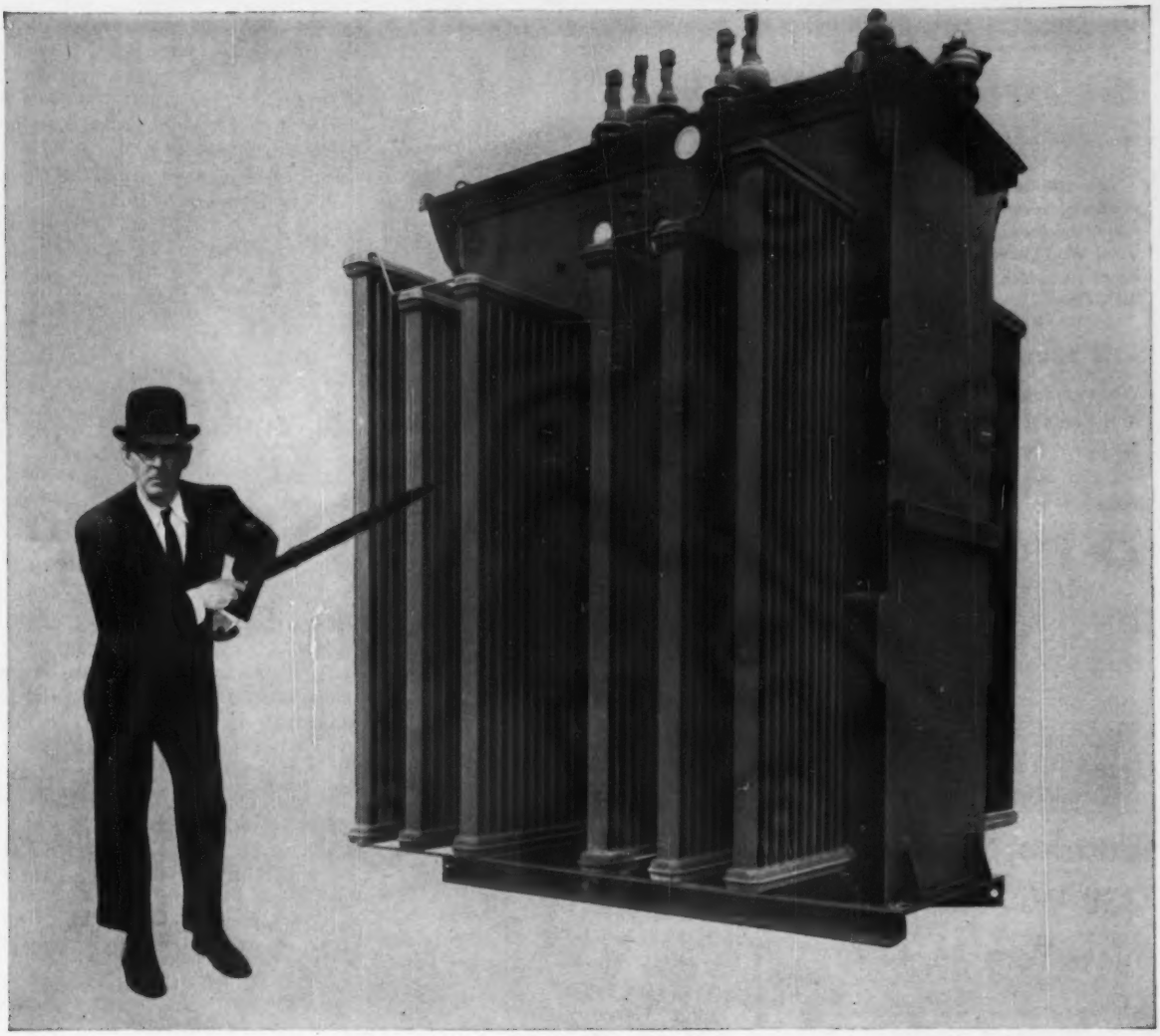
. . . has BIL rating of 900 kv. The new unit of the type SCW line of current transformers is oil-filled, hermetically sealed and corona-free. It was designed for heavy-duty metering and relaying service. Improved insulation and more effectual use of materials have permitted weight reduction to about that of a 250-kva distribution transformer.
Allis-Chalmers Mfg Co, Milwaukee 1, Wis.



Power Fuse . . .

. . . has fiberglass fuse holder and contacts that prevent damage under heavy fault conditions. Types HPA (shown) and BPA have better latching and are easier to operate by hookstick than superceded models. Type HPA ratings are 7.2 to 161 kv, loads to 400 amp, and interrupting capacities as high as 3,480 Mva. Type BPA fuses are furnished in ratings from 7.2 to 60 kv for load currents of 100 and 200 amp and at interrupting ratings to 934 Mva.
Southern States Equipment Corp, Hampton, Ga.

(*More New Equipment on page* 76)



TIGHTEST MAN IN TOWN BUYS I-T-E TRANSFORMER. HERE'S WHY.

He did it to save money, of course. And he turned down a flock of other make transformers with actually lower price tags. You see, the economy of a transformer isn't all in the original price. A cheaper transformer that gives you trouble later can cost a fortune.

But I-T-E is a company that still builds transformers the way they should be built—with stronger construction, superior insulation, and lower operating losses. An I-T-E transformer can take the shock of heavy faults that can tear less expensive transformers apart. It makes less noise than the cheaper transformer. It can endure heavy loads and hot days. And it doesn't weaken even after years of use.

That's why so many really smart tightwads gladly pay the few extra dollars for an I-T-E transformer. They know it means greater real economy in the long run.

Write for detailed Bulletin 5804-1A. I-T-E Circuit Breaker Co., Dept. TR, 1900 Hamilton Street, Philadelphia 30, Pa.

I-T-E | **I-T-E CIRCUIT BREAKER COMPANY**

Readers Service

For additional information on new products, supplies, and services in this issue, the Manufacturers Editor of Electrical World offers his facilities. Check items in which you are interested in list below:

NEW EQUIPMENT

Westinghouse.....Power Recloser ☐
Allis-Chalmers .....CT ☐
Southern States.....Power Fuse ☐
Packard Bell....Digital Computer ☐
Valley Mfg....Lighting Standard ☐
Kearney.....Hot Line Tool ☐
Analytical Measurements.....pH Meter ☐
Hughes .....Battery Charger ☐

OTHER

Manufacturers Editor
Electrical World
330 W. 42nd St.
New York 36, N.Y.

* Note: Requests must be received within four weeks of publication date, accompanied by complete information specified. This service cannot be offered to readers in foreign countries or to competitive manufacturers.

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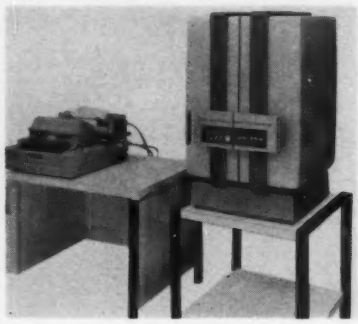
Reference ..... ☐
Specs ..... ☐
Trial ..... ☐
Purchase ..... ☐

JUNE 6, 1960



Digital Computer . . .

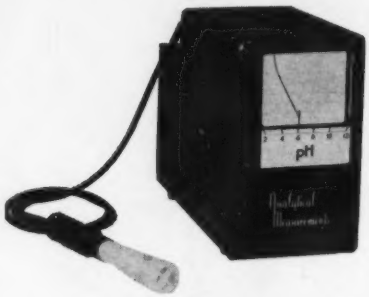
. . . for engineer's desk-side use is compatible with equipment for other manufacturers. A line of peripheral units is also offered. The PB250 will serve also as an on-line computer for process control and monitoring and for data-logging. Internal memory holds up to 15,-888 21-bit words. Typewriter is among the input units available.
Packard Bell Electronics, 12333 W Olympic Blvd, Los Angeles 64, Calif.

Lighting Standards . . .

. . . of 3, 7 or 11 gauge steel are for street or commercial lighting. Mast arms and bracket arms as well as a variety of tapered poles are available.
Valley Manufacturing Co, Valley, Nebr.

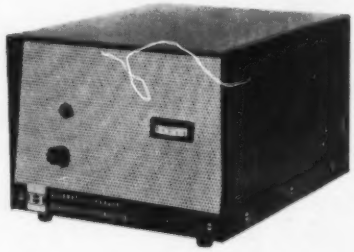
Hot Line Tool . . .

. . . is bright yellow for good visibility in natural or electric light and to show dirt or grease readily on its non-porous, easily cleaned surface. The fiberglass clamp stick has high dielectric strength and has been tested to withstand 100 kv per ft for 5 min. It is furnished in 4 to 12-ft lengths.
James R. Kearney Corp, 4236 Clayton Ave, St. Louis 10, Mo.



Recording pH Meter . . .

. . . marks continuous trace on an integral strip chart, whose speed is adjustable from 1 to 16 in. per hr. At the slowest speed, the 63-ft paper chart roll lasts 31 days. Automatic temperature compensation through addition of a platinum resistance thermometer can be provided. The combined pH meter and recorder contains printed circuits.
Analytical Measurements, Inc, 585 Main St, Chatham, N. J.



Battery Charger . . .

. . . gives automatic stepless control of charging current and voltage, regardless of line voltage or frequency fluctuation. Output ratings are 1 amp and 3 amp, 6-120 v dc. Input is single phase. The silicon battery charger provides fine regulation and tapers off final charging current to a low value.
Hughes Electronics Co, 5343 Crenshaw Blvd, Los Angeles 43, Calif.

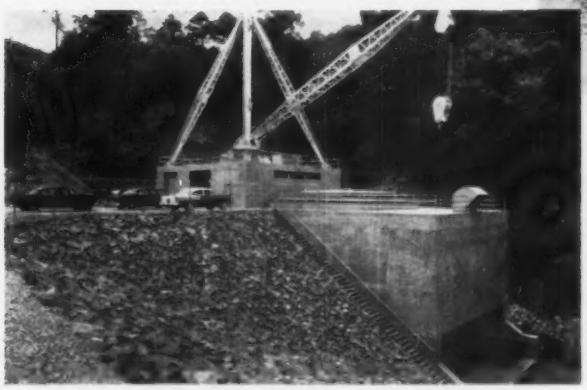
TVA relies on Leffel Turbines

AT WILBUR DAM

In 1950, when the Tennessee Valley Authority decided to expand the capacity of the Wilbur Dam Power station, a Leffel vertical shaft propeller-type turbine was selected. This turbine is rated at 11,500 HP, operating at 180 RPM under a net head of 67 feet.

AT CHATUGE DAM

The Leffel turbine at Chatuge Dam, another TVA installation near Murphy, North Carolina was also installed in 1955. This turbine is rated at 13,000 HP at 180 RPM under a net head of 100 feet.



AT NOTTELY DAM

At TVA's Nottely Dam on the Nottely River near Murphy, North Carolina the generator is driven by a Leffel turbine installed in 1955. This turbine is rated at 21,000 HP, operating at 180 RPM under a 124 foot net head.

These three turbines have given entirely satisfactory service from their initial installation.

. . . AND SO CAN YOU

Whatever your waterpower requirements you'll find Leffel turbines tops for efficiency and reliability. And Leffel engineers, drawing on nearly a century of experience, are available without obligation to help you plan the installation which will give you maximum power from available water.

Whether you're planning the rehabilitation or expansion of existing facilities or the construction of a completely new installation, be sure to find out what Leffel can do to help you.

1108-E

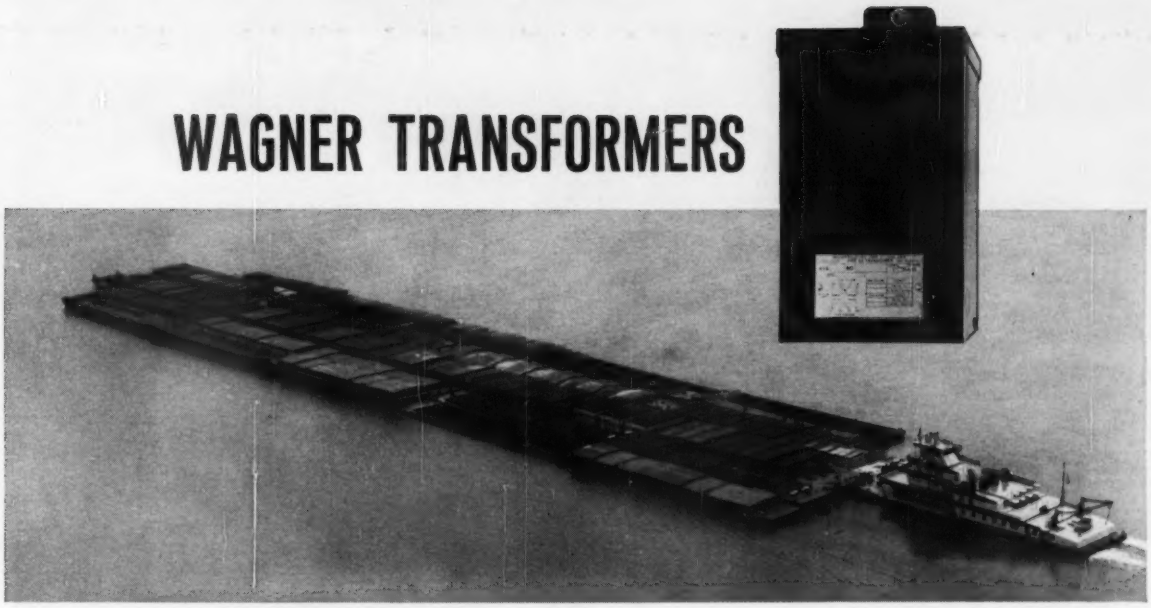
FOUNDED IN 1862

THE JAMES LEFFEL & CO.

DEPARTMENT M • SPRINGFIELD, OHIO, U. S. A.

MORE EFFICIENT HYDRAULIC POWER FOR 98 YEARS

WAGNER TRANSFORMERS



RIDE OL' MAN RIVER

Out in the channel, that's Federal Barge Lines' M.V. UNITED STATES. Designed and built by St. Louis Shipbuilding & Steel Co., she's the most powerful towboat on America's inland waterways. Headed up the Mississippi, this 8,500 horsepower giant pushes a record-breaking 42 barges, the equivalent of seven and one half acres. The boat is designed to push 40,000 tons of cargo, the capacity of a freight train 1,000 cars long.

You'll find seven Wagner Dry-Type General Purpose Transformers on duty aboard the UNITED STATES. Six 10 Kva and one 7½ Kva transformers (all 480 volt primary, 120/240 volt secondary, with 2 extra primary taps) are used to power this muscled lady's lighting system, small motors, and most of her navigation equipment.

Ashore or afloat, Wagner Type AE Transformers can be used for all general purpose applications, including those where noise must be minimized. They have a low sound level, the result of encasing smaller Form W core and coils in solid epoxy compound... give you a whisper-quiet transformer that can be used anywhere noise would be a nuisance.

Wagner Type AE Transformers have insulation protection suitable for continuous operation at 80°C in a 40°C ambient. All parts are sealed from dust, moisture, and corrosion by the epoxy compound. Naturally, every unit is built to conform to all applicable standards of ASA and NEMA.

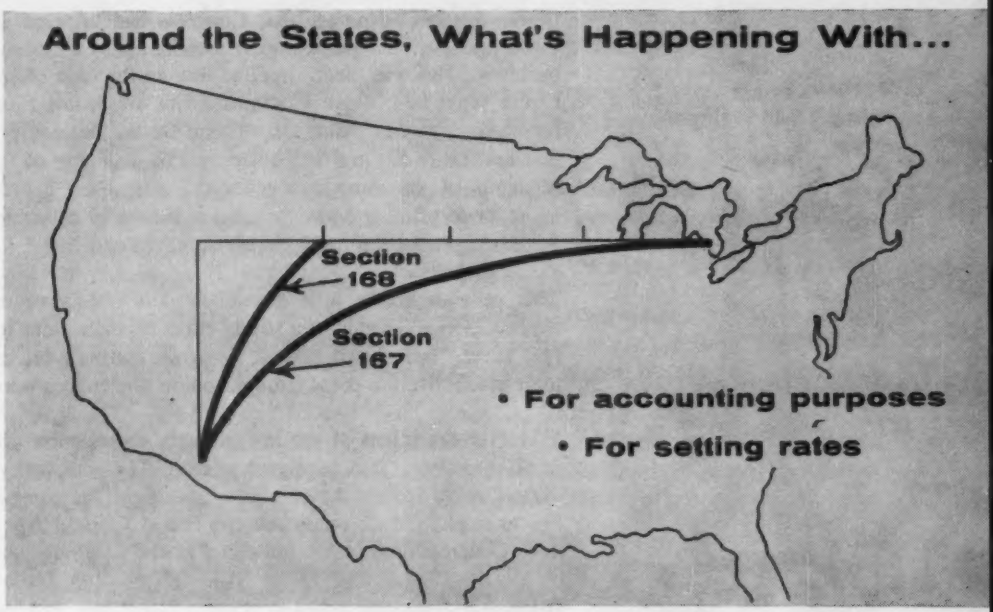
Wagner Type AE Transformers can be installed indoors or out... anywhere they will not be submerged or exposed to injurious fumes in concentration. Compact and lightweight, they can be mounted in any position at any angle, on walls, floors, or ceilings.

Like to know more? Wagner branches and distributors have all the details. There's one near you, listed in your 'phone book. Call or write. Soon.

WT60-13

Wagner Electric Corporation

6456 PLYMOUTH AVENUE, ST. LOUIS 33, MISSOURI



Report on
Depreciation

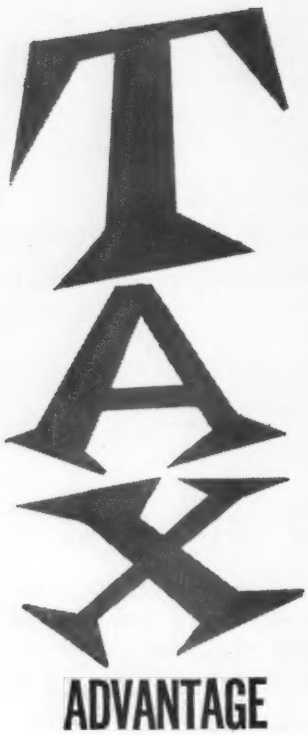
Which Way With LD and AA?

It's been a long scrimmage for LD and AA rooters. They've witnessed a few victories. But after six years of contests with the state commissions and some courts, they've watched Liberalized Depreciation (LD) and Accelerated Amortization (AA) thrown for one loss after another. Even some of the most avid fans are losing heart. What's the score?

The utilities have never asked for more than equal treatment under sections 167 and 168 of the Internal Revenue Code of 1954, whose benefits Congress intended for all business. But equal treatment has drawn an increasingly dim view from the regulators. This fact is crystallizing: For many utilities, the benefits of AA and LD must be (1) passed along to their customers, or (2) passed up altogether by reverting to conventional, straight line depreciation for tax purposes.

Section 167 of the code opened the door for liberalized depreciation, allowing companies to write off as much as two-thirds of the cost of new plant or equipment in the first half of its service life by using the declining balance or sum of the years digits method. And Section 168 went still further. It allowed companies to accelerate the amortization period to recover the full cost of certified emergency facilities in the first five years of their service life, even though actual life was much longer. Except for the utilities, most U.S. corporations enjoy the full benefits of the Code. A recent survey of 994 companies by Controllers Institute Research Foundation indicates around 78% of all companies benefit fully from liberalized depreciation.

Both 167 and 168 are only interesting for their impact on income taxes. By writing off a much greater amount of an asset's cost early in its service life, companies pay lower taxes than they would have with straight line depreciation at



that time. Later, of course, taxes rise accordingly, as depreciation expense is reduced. There is no permanent tax saving over the life of an asset. But for a group of assets in an expanding company there may well be a permanent tax saving—if the company goes on expanding forever.

It was this tax advantage that Congress had in mind when it wrote the 1954 Code into law. Its purpose was to stimulate expansion and modernization in business. This was clearly spelled out, in the case of section 167, by both the House Ways and Means Committee and the Senate Finance Committee. They reported, ". . . The faster tax writeoff would increase available working capital and materially aid growing businesses in financing of their expansion. For all segments of the American economy, liberalized depreciation policies should assist modernization and expansion of industrial capacity, with resulting growth, increased production and a higher standard of living."

This opinion seems well grounded. U.S. businessmen have indicated that depreciation policies have a strong effect on their plans for growth. A McGraw-Hill survey has shown that 45% of the nation's businesses would accelerate their modernization plans if depreciation allowances were liberalized.

Whatever the intent of the law, though, commission opinions have veered off in all directions. It is hardly surprising. The complexity of the problem stands in bold relief against the number of questions the commissions and courts face. For example, did Congress actually intend LD and AA for the utilities? If so, does Congressional intent transcend states which regulate local utilities?

Other questions are equally vexing. What tax expense should a utility be allowed? With "flowthrough," only actual taxes are considered as an operating expense; thus the customers, not the utility, get the advantage of lower initial taxes with LD or AA. (Future customers, of course, will pay higher rates because of higher taxes.) On the other hand, if taxes are "normalized" the utility reports normal, straight line depreciation as an operating expense, even though it paid lower taxes because of LD or AA. Thus, with normalization, present and future ratepayers share equal tax burdens (and pay the same rates as if straight line had been used) but the utility can employ the temporary tax savings for expansion. Who should benefit from the savings, the utility, its customers, or both?

Recent decisions show the commissions have not answered such questions to the satisfaction of many a utility. The April 21 report of the Special Committee on Tax Amortization of the American Bar Association lists all known rulings on both sections of the Code. Taking only recent years, since 1957 alone there have been 124 rulings on liberalized depreciation and 43 on accelerated amortization. During this period, roughly 40% of the rulings knocked down virtually all the benefits of liberalized depreciation. And most of the remainder allowed the utilities only partial benefits. The record of accelerated amortization over the same period has been only a little more encouraging.

Commission and court rulings have shown a remarkable inconsistency on both sections of the Code. Orders have ranged from full benefits with normalization to outright denials. Meanwhile, such venerable bodies as the Federal Power Commission and the Securities & Exchange Commission have taken a more liberal stand, conveying a belief that Congress did, indeed, intend LD and AA for use by the utilities. FPC, in May, 1958, amended its accounting procedure to provide for normalization. The Commission expressed its belief at that time that its new accounting procedures would accomplish Congressional purpose. FPC has also pointed out that deferred tax accounting is not mandatory for any utility which, in accordance with consistent policy, elects not to employ it, even though LD and AA are used in computing income taxes. Recently, the SEC struck a similar note in its own accounting ruling.

What's going on around the states today? A recent study by Ebasco Services, Inc, New York consultants, shows where commissions stand at this time. It includes all known rulings on both sections, for accounting purposes, and for setting rates. Here are the results.

Liberalized Depreciation—For Accounting Purposes

Three states permit or require normalization of taxes, but have ordered deferred taxes credited to restricted surplus. The states, according to the Ebasco study, are Florida, Virginia, and West Virginia.

Twelve states have ordered normalization, with tax deferrals credited to a reserve account. The states: Arkansas, Georgia, Hawaii, Illinois, Kansas, Louisiana, Massachusetts, Minnesota, Nebraska, New Mexico, Ohio, and Tennessee.

Seven other states strike the middle ground, allowing specific utilities to normalize taxes, with deferrals placed in either a surplus or reserve account. The states: Alabama, Colorado, Indiana, Kentucky, Michigan, Oklahoma, and South Carolina.

Seven states don't allow normalization for accounting purposes. Only actual taxes reported on the income statement are to be used. The states: Arizona, Maine, Missouri, New Hampshire, New Jersey, New York, and Vermont.

All alone, the Wisconsin PUC allows normalization, but requires taxes deferred to be charged to depreciation expense and credited to depreciation reserve (this has the effect of reducing the rate base by the amount of the temporary tax saving).

Liberalized Depreciation—For Setting Rates

Rate setting is, of course, the key issue in the handling of either form of accelerated writeoff. Eight states have gone almost all the way, permitting normalization without deducting deferred taxes from the rate base (deferrals are credited to a reserve or restricted surplus account). The eight states: Florida, Indiana, Louisiana, Massachusetts, Nevada, New Mexico, Oklahoma, and Wyoming. The Indiana Commission's order permitting normalization has been sustained by an Indiana Circuit Court, and was upheld before the state Supreme Court about a year ago.

Eight other states allow normalization, but don't allow the utility to earn a rate of return on the fund accumulated through tax deferrals. In other words, they either subtract the reserve or surplus accounts from the rate base, or consider the deferred taxes as interest-free capital in figuring the utility's overall cost of capital in arriving at a rate of return. The states: Georgia, Hawaii, Illinois, Kansas, Kentucky, Michigan, Ohio, and Oregon.

The Illinois Commission, in its latest ruling, allowed normalization, with the tax deferral to be considered an interest free loan. However, the Illinois Supreme Court, on January 22, 1960, disallowed normalization in the Alton Water Co. case. But later, on April 1, the Supreme Court, in a reversal on appeal, allowed normalization of taxes, but required deduction of reserve from the rate base.

Flow-through is mandatory under section 167 for thirteen states and the District of Columbia, thus passing tax savings along to the customer. The most extreme case, of course, has been the Maine decision, where the Commission adjusted Bangor Hydro-Electric's net income upwards just as though liberalized depreciation had been taken, even though the company had used the straight line method. The thirteen states: California, Connecticut, Idaho, Maine, Missouri, New Hampshire, New Jersey, New Mexico, New York, North Dakota, Pennsylvania, South Carolina, and West Virginia. Flow-through has been

upheld by the Supreme Courts of Maine, North Dakota, and Pennsylvania.

Accelerated Amortization—For Accounting Purposes

Fifteen states require normalization of taxes, with temporary tax savings credited to a restricted surplus account. The states: Alabama, Colorado, Florida, Kentucky, New Hampshire, New Jersey, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina, Virginia, Washington, West Virginia, and Wyoming.

Twelve other states require normalization with deferrals credited to a reserve account. The states: Arkansas, Connecticut, Georgia, Hawaii, Illinois, Indiana, Kansas, Louisiana, Massachusetts, Missouri, New Mexico, and Utah.

California, Idaho, Maine, North Carolina, and Oregon are divided. Each has issued two separate orders stating normalized taxes are to be credited to (1) reserves, and (2) restricted surplus. Michigan has required two utilities to credit restricted surplus and the rest to credit reserve.

In New York, taxes are to be normalized below the line for accounting purposes, with savings placed in an account that does not represent free surplus. As before, Wisconsin follows the unusual procedure of normalizing the deferral through depreciation expense, crediting the depreciation reserve.

Accelerated Amortization—For Setting Rates

Nine states have permitted normalization of taxes for rate setting under section 168, the Ebasco study shows. The states: Arkansas, California, Colorado, Florida, Indiana, Louisiana, Maine, New Jersey, and Virginia. The Supreme Courts of Maine and Virginia have upheld Commission rulings, as have State Courts in Indiana. New York allows normalization under 168 for rate setting, but specifies that it must be done below the line (i.e., the deferred taxes are not treated as an operating expense in rate determinations).

Three states permit taxes to be normalized and treated as an operating expense, but deduct the deferrals from the rate base. The states are Hawaii, New Hampshire, and Pennsylvania. The Georgia Commission, in a temporary order, would require tax reserves to be subtracted from the rate base. Idaho, Illinois, Oregon, and Washington allow normalization, but consider the tax deferrals as interest-free capital in figuring rate of return. One state, North Dakota, does not allow taxes to be normalized.

• • •

Clearly, the national situation is chaotic. The lack of consistency between the state jurisdictions, and even between the states on one hand, and the FPC and SEC on the other, has produced an irritating and sometimes increasingly difficult situation. Is the game worth the candle? That's a question some utilities may now be asking. Liberalized depreciation is beginning to look more and more like a dead end road that may eventually involve inconvenient and costly backtracking. Possibly, the only practical answer lies in an outright abandonment of the 1954 Code's benefits by the utilities themselves, by switching back to conventional, straight line methods. It is significant that the nation's largest utility, American Telephone & Telegraph, has never made use of 167. AT&T prefers, instead, to concentrate on a bigger target—economic depreciation.

One big problem the utilities would have to face now if they were to voluntarily give up the provisions of section 167, would be the way in which the regulators treat the tax deferrals that are already on the books. Presumably, the best that could happen would be a direct transfer of the accumulations to earned surplus. And the worst would be to amortize these balances through income.

Philadelphia apartment house . . .

Features Electric Heating, Cooling, Appliances

All-electric heating, cooling, lighting and appliances will be featured in an all-electric apartment house to be constructed on Philadelphia's "Golden Strip." The 13-story, 132-unit building is claimed to be the largest all-electric apartment house in the country.

The apartment units will not be separately metered.

Each room will have electric baseboard heating and a built-in air conditioner, with thermostatic temperature control. Each apartment will have an electric water heater with thermostatic control, an electric range, oven, refrigerator, garbage disposal unit and dishwasher.

An electric heating cable embedded in the concrete at the entrance and exit ramps to the garage will keep them free of ice and snow.

Each apartment will have planned lighting designed by residential lighting consultants of Philadelphia Electric Co.

Total connected load will be 2,200 kw in summer and 2,800 kw in winter. Approximate demand load in summer will be 1,000 kw, and in winter, 1,200 kw.

Service will be at 13.2 kv from two 3-phase underground cables in conduits encased in concrete. Primary service equipment will consist of metal-clad switchgear, containing two power circuit breakers of 150,000-kva interrupting capacity. A similar circuit breaker will be used as a tie breaker for automatic throwover.

Transformers will be an application of a double-ended load-center unit substation stepping down to 120/208 v. The substation will contain two, 1333-kva, open-ventilated dry-type transformers. Low-voltage switchgear will consist of two main air-circuit breakers and a bus-tie breaker, operated with automatic throwover. The eight feeder circuits will be protected by manually-operated, stored-energy circuit breakers.

Secondary distribution from the feeder breakers will be 3-phase, 4-wire, radial feeders. Overcurrent circuit breakers will be applied at each floor ahead of conduit and wire runs to apartment load centers.

These load centers will provide circuit breaker overcurrent protection for all circuits within the individual apartment. Silent-type switches will be used for control of lighting circuits.

Commenting on the selection of electric heat for the apartment house, R. R. Graham, general manager, electric resistance comfort heating section, of General Electric Co said, "you have a clean and wholesome atmosphere because electric heat eliminates the need for ducts, registers, or fans that collect and distribute dust."

Georgia Said to Head US in Commercial Heat

Georgia now leads the nation in the number of electrically heated commercial buildings, the Georgia Power Co reports. Company engineers pointed out that there are 1,400 commercial buildings, and structures containing all-electric heating installations are being added

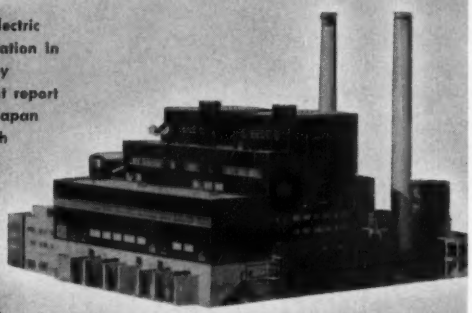
(*Continued on page* 86)

4 OUT OF 6

CHIBA STATION
9224 BTU/KWH
(Tokyo Electric Power Co., Inc.)

Of the six most efficient electric generating plants now in operation in Japan, four were designed by Gilbert Associates, Inc. A recent report of plant performance by the Japan Electric Association shows each of these stations as having an average annual net heat rate below 9800 BTU/KWH.

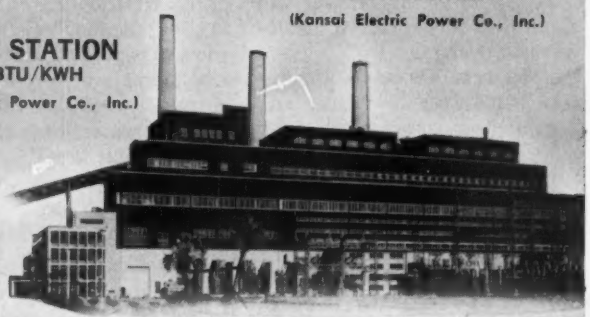
Gilbert is pleased to be associated with the operating and manufacturing companies who participated in the establishment of this commendable record.



TANAGAWA STATION
9560 BTU/KWH
(Kansai Electric Power Co., Inc.)

OSAKA STATION
9614 BTU/KWH
(Kansai Electric Power Co., Inc.)

KARITA STATION
9779 BTU/KWH
(Kyushu Electric Power Co., Inc.)



A SYMBOL OF GAI PROGRESS

GILBERT ASSOCIATES, INC.
ENGINEERS AND CONSULTANTS
READING, PENNSYLVANIA, U. S. A.

(*Continued from page* 85)

to company lines at an average of 55 a month.

Credit for this splurge was given to the company's rates for commercial customers. "Additional credit should go to great technological improvements in electric heating in recent years," said Georgia Power's J. W. Sweatte. "The maximum capacity of heat pumps has multiplied 10 times in the past two years, making them capable of heating any size building."

Georgia Power has a corps of 42 electrical engineers specializing in adapting electric heat for commercial purposes.

BH&G Ads Give Double Impact to Electric Heating

Two ads on facing pages in the June issue of "Better Homes & Gardens" will give double impact to electric house heating.

One ad is sponsored by the Edison Electric Institute Live Better Electrically Program and is headlined, "Today Clean Electric House Heating Costs Less Than You Think." Copy is editorial style. The other ad, sponsored by the National Electrical Contractors Assn, says, "And Your Installation Is Guaranteed When It Is Put In By a Qualified Electrical Contractor."

The LBE ad stresses consumer benefits of electric heating, and the NECA ad tells how benefits of heating can be achieved by using a qualified electrical contractor.

Refrigerators Score as 'Most Wanted' Appliance

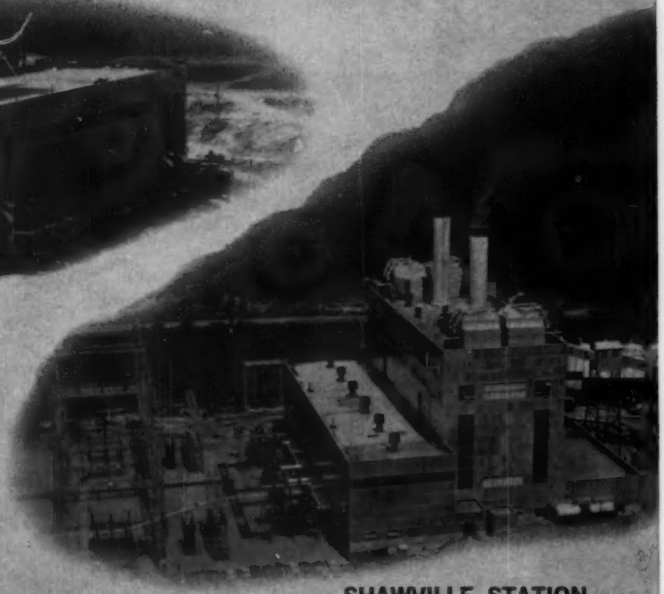
Refrigerators rate top-billing as the "most wanted" major appliance in one section of the country. This was evidenced by a recent analysis of the results of a "$20,000 Electrical Prize Drawing" conducted by the Northern California Electrical Bureau.

Refrigerators received the largest rate of response with 16.6%. Clothes washers followed at 14.5%. Third place went to TV sets which

(*Continued on page* 88)

3 UNDER 9400

SILAS C. McMEEKIN STATION
9093 BTU/KWH
(South Carolina Electric & Gas Co.)



SHAWVILLE STATION
9163 BTU/KWH
(Pennsylvania Electric Co.)

MILLIKEN STATION
9378 BTU/KWH
(New York State Electric & Gas Corp.)

Gilbert Associates, Inc., is proud to have contributed to the creation of many outstanding power generating facilities throughout this country and the rest of the world. We are particularly pleased with the fact that the Federal Power Commission's latest report (S-137) shows three of these Gilbert designed stations among the U. S. generating plants whose Average Annual Net Station Heat Rate is under 9400 BTU/KWH.

A SYMBOL OF GAI FOUNDED 1906 PROGRESS

GILBERT ASSOCIATES, INC.
ENGINEERS AND CONSULTANTS
READING, PENNSYLVANIA

Widely used on

- Insulator pins
- Crossarm bolts and braces
- Clevises and clamps, etc.

- **Eliminate checking and re-tightening**
- **Eliminate radio interference due to loose hardware**

Every bolt - and - nut assembly locked with PALNUT Lock Nuts stays tight, despite weather, wind, stress and vibration. PALNUTS, tightened on top of the regular nuts, prevent loosening and falling off. Very low in cost—easily, speedily applied — require little space — may be used on new or existing assemblies. Hot dip galvanized, silicon bronze and other materials and finishes. Stocked by all leading pole line hardware manufacturers.

The PALNUT Co.
DIVISION OF
UNITED-CARR
FASTENER CORP.
51 Glen Road
Mountainside
N. J.

PALNUT
TRADE MARK
LOCK NUTS
for quick, secure fastening at low cost

(*Continued from page* 86)

received 11.8% of the response.

Among portable appliances, frypans were listed by 1.6%, mixers, 1.2%, and toasters, 1.0%.

A major appliance was asked for by 84.7% of the entrants; 6.6% selected a portable kitchen appliance, and the remaining indicated housewares.

The figures were secured from a "$20,000 Electrical Prize Drawing" contest. Entry blanks were sent out with Pacific Gas & Electric Co bills to approximately 1,800,000 electric customers. More than 75,000 persons deposited entry blanks in dealers' stores. A space was provided on each entry blank for customers to write in what electrical appliance they would buy next.

Magazine Article Deals With Good Street Lighting

"To Make Streets Safe After Dark" is the title of an article appearing in the June *Reader's Digest*. The article is a condensation of one which appeared in the *National Civic Review*, April, 1960. The article gives further evidence to support the theory good street lighting cuts crime and traffic accidents.

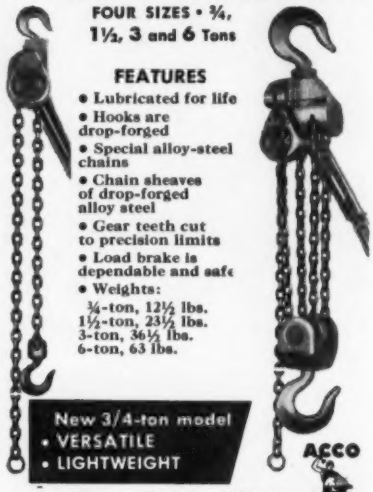
The article points out that 73% of the nation's murders, assaults, rapes and muggings are committed after dark, and that half of these crimes could have been prevented with adequate street lighting. Studies also show that substandard lighting is responsible for 10,000 after-dark traffic deaths, and half a million injuries.

Fewer than 20 of the 18,000 incorporated towns and cities in the US are completely equipped with lighting that meets the minimum code levels approved by the American Standards Assn.

The cost of street lighting improvement is minimal, according to the *Digest* article. Present per-capita share of the nation's street and highway lighting bill runs between 90 cents and $1.40 a year. Experts say that an additional $340 million a year, less than $2 a person, would assure safety-code lighting for every street in the nation, plus all danger spots on open highways.

(*Continued on page* 89)

NEW 3/4-ton Pull-A-Way
Added to WRIGHT TYPE "C" LINE!



FOUR SIZES • ¾, 1½, 3 and 6 Tons

FEATURES
- Lubricated for life
- Hooks are drop-forged
- Special alloy-steel chains
- Chain sheaves of drop-forged alloy steel
- Gear teeth cut to precision limits
- Load brake is dependable and safe
- Weights:
  ¾-ton, 12½ lbs.
  1½-ton, 23½ lbs.
  3-ton, 36½ lbs.
  6-ton, 63 lbs.

New 3/4-ton model
• VERSATILE
• LIGHTWEIGHT

ACCO

Write to York, Pa., office for complete information

Wright Hoist Division
AMERICAN CHAIN & CABLE
York, Pa., Bridgeport, Conn.

...For Locating Faults in Lead-Covered Cable
...For D-C Proof Testing

Has applications on aerial, or buried cable, as well as on lead-covered cable installed in ducts. Equipment combines a high-voltage capacitor discharge transmitter with a detector to form a complete Tracer Current Set. Provides high current and voltage output with small energy input. Equipment is moderate in size, weight and cost. Use is not restricted by networks or branches, and under certain conditions will even operate successfully without disconnecting transformers. Method of detection indicates whether fault has been reached or passed when an exploring pick-up coil is applied at various points along the cable.

Biddle Models	Output Voltage	Discharge Capacitance
Catalog 651125	Up to 25 KV	1.65 muf
Catalog 651015	Up to 15 KV	2 muf
Catalog 651005	Up to 5 KV	16 muf

B-1005 **Write for Bulletin 65-W**

BIDDLE
JAMES G. BIDDLE CO.
Electrical and Speed Measuring Equipment
1316 Arch Street, Philadelphia 7, Pa.

(*Continued from page* 88)

These rules for adequate lighting are stressed in the article: Do fixtures throw light against walls and into the air rather than where it is needed; are there alternating patches of light and darkness; do the lights throw confusing reflections off wet pavements?

Reprints are available from: Reprint Editor, The Reader's Digest, Pleasantville, N. Y.

SELLING BRIEFS

An 11-mile section of the New England Thruway will be lighted soon. Orders for 170 underpass **luminaires,** 20 poles of mercury floodlighting for interchanges, and 1,040 mercury lamps for the highway have been given to Westinghouse Electric Corp.

Two-page newspaper editorial material dealing strictly with **electric heating** has been sent to 10,960 newspapers through the nation by Edison Electric Institute. In addition, supplement went to managing editor, real estate editor, and advertising director in 420 of the largest daily newspapers.

Three **gas refrigerators** have been introduced by Whirlpool Corp. Models have freezer and refrigerator compartments, automatic ice maker, "jet-cold" shelf and "spot-cold" temperature control. Prices are higher than for comparable electric models.

The chance to make **thermoelectric refrigeration** economically practical is claimed by General Thermoelectric Corp. The company will market cooling devices made of a Canadian-developed material called Neelium. The material is a solid semi-conductor of electricity made of bismuth, tellurium selenium, and antimony.

Model data for 1960 room **air conditioners** are available from National Electrical Manufacturers Assn. Data includes model numbers of different units, Btu-per-hr cooling capacity, horsepower rating, volts, watts, amperes, and whether or not the units heat as well as cool.

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Brunzell Elected President of WWP

George M. Brunzell has been promoted to president of the Washington Water Power Co. Kinsey M. Robinson who had been president retained the positions of board chairman and chief executive officer.

Brunzell started with WWP as an electrician at Pullman, Wash., after graduating from the University of Idaho. He was named division engineer for the Bend Division in 1939, later serving as division engineer at the Coeur d'Alene Division. In 1943, he was transferred to Spokane as assistant superintendent of the Spokane Division and in 1946 was named division superintendent.

BRUNZELL

Brunzell became division manager of the Spokane Division in 1955 and the following year was named vice president and assistant to the president. He then became executive vice president of the company in 1958.

Robinson has been president of Washington Water Power since 1938. He has been board chairman since 1952. After working for the Idaho Power Co from 1911 to 1938, lastly as president, he then joined WWP as president.

Robinson pointed out that the change does not mean he is retiring. "It does mean that I will be relieved of the tremendous amount of detail associated with the presidency," he said, and noted that he will spend more time on financing, power supply and power problems.

ROBINSON

A. B. Chance Co Chooses Toalson for President

TOALSON HANSEN HOUGH ARNDT CURTRIGHT

A. B. Chance Co has elected Nathan A. Toalson president. He succeeds F. Gano Chance who will continue as senior officer, chairman of the board and chairman of the executive committee.

Toalson had been executive vice president of the power and communication equipment manufacturing firm since 1956.

L. C. Hansen has been made vice president and general manager of the Chance Division, largest of the company's three major divisions. He will direct marketing, manufacturing and engineering functions of the company's Centralia, Mo., Pittsburgh, San Francisco, and Parkersburg, W. Va., operations. Hansen had been vice president of the company's marketing operations since 1955.

C. C. Hough has been elected vice president and treasurer, and Joseph M. Arndt has been appointed vice president of industrial and public relations.

J. S. Curtright has been named regional vice president, heading a new sales region serving several central states.

G. M. Daly has been advanced to sales manager, and Charles Rootes to controller.

(*More News About People on p* 92)

Sandersville, Georgia...

5700-member Co-op boosts revenues $1000.00 a month with General Electric Skillets

Robert E. Tanner, Jr.
Field Services Manager, Georgia Electric Membership Corp.

"The members of our state-wide Power Use Committee were tremendously impressed by the results achieved in our recent skillet promotion.

"Our Washington County co-op, located in Sandersville, has a total membership of only 5702. They sold 2116 skillets to their members. In the first full month following the promotion, they showed a measured increase in revenue of slightly over $1000.00.

"Many other co-ops have reported an outstanding response to the skillet offer. For example, Little Ocmulgee EMC of Alamo, Georgia, sold 1476 skillets. Their total membership is only 4096."

This state-wide promotion—arranged with the cooperation of the General Electric District Representative—was built around a consumer advertisement inserted in the Georgia EMC publication.

Co-op members were offered a free home trial. Some co-ops provided credit; the small monthly payments were added to customers' electric bills. And employees of the co-ops were enlisted in the campaign.

The result? Thousands of new converts to "table-top" cooking—and a striking rise in revenues.

Are *you* taking advantage of the favorable opportunities for extending power-use through General Electric's "table-top" cooking appliances? General Electric's Utility Promotion Program offers assistance in meeting local problems—plus heavy advertising support in the nation's leading magazines, and a regular schedule in Electricity on the Farm.

To find out how this General Electric power-use program can help you in your area, write to General Electric Company, Portable Appliance Department, Bridgeport 2, Conn., Attn. Merchandising Section.

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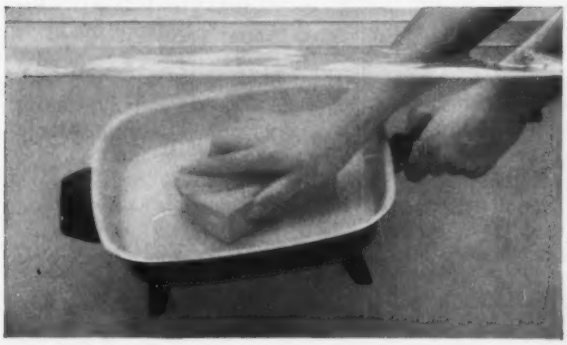
GENERAL ELECTRIC

Every one of these General Electric Skillets sold adds $5.40 a year to utility revenues...

Automatic Skillet—removable thermostatic control assures peak flavor automatically. Skillet completely immersible for easy washing. Comes in 11" and 12" sizes.



Tip-Top Skillet—"Fifth leg" pulls down out of handle, tilts skillet so food drains as it fries. Removable tilt-top lid serves as spatter shield. In 11" and 12" sizes.

Charles C. Wolf has been named manager of transmission and distribution for the Potomac Edison System.

Duke Power Co has made the following appointments: **Kelly W. Sullivan** to the industrial development department; **W. S. Lee,** assistant to the chief engineer; **L. C. Dail,** civil engineer in charge of the civil engineering section; **C. J. Wylie,** electrical engineer in charge of the electrical engineering section; **A. W. Kemp,** instrument supervisor and **W. C. Leary,** meter supervisor, operating department. **T. M. Patrick Jr** has been promoted to assistant to the manager of the Charlotte district office; **Henry W. Anderson,** manager of the Leaksville branch; and **Jack G. McCachern,** manager of the Taylorsville office.

Mississippi Power & Light has promoted: **A. T. Snider** to division manager of the Northern Division; **Charles R. DeKay** to division engineer, North Central Division; **John R. Craft,** division engineer, South Central Division; **J. R. Dickson,** assistant to the manager of division operations, at the general office; **T. K. Hawthorne,** manager at Charleston; **T. B. Worley,** manager of the Durant-Kosciusko-Carthage area of the Central Division; **Tom Box,** commercial-industrial salesman for the Delta Division; **George L. Smith,** commercial-industrial salesman in Indianola; **Hiram Walters,** commercial salesman in Grenada; and **Jack Spradling,** residential salesman, Vicksburg.

Central Illinois Public Service Co has appointed **Howard N. Diller** Western Division engineer, succeeding **E. D. Hartzell,** retired; **William H. Cowen,** Western Division auditor, replacing **LaMont Gist,** retired; and **George P. Kolinski,** distribution engineer. The distribution and transmission operations will be combined into one section under the supervision of **T. N. Cofer,** who becomes transmission and distribution system engineer.

Stewart P. Brownell, Cleveland Electric Illuminating Co, has been elected first vice president, Purchasing Agents' Assn of Cleveland.

Idaho Power Co has appointed **Milton T. Sargent** Eastern Division manager, succeeding **L. W. Brainard,** retired.

Seattle City Light has appointed **Gene Lasater** distribution program coordinator.

Pacific Power & Light Co has set up an industrial reference library and appointed **William L. Hutchinson** to organize and direct it.

Appalachian Power Co has made these changes: **B. D. Painter,** system supervisor of rates and contracts; **John W. Vaughan,** system supervisor of commercial and industrial sales; and **Jack M. Burnett,** Roanoke Division commercial manager.

Puget Sound Power & Light Co has made three changes in its operating department. **Emmet P. Kelly** takes on added responsibilities as assistant manager of operations and coordinator of civil defense; **Kenneth L. Harvey** is now supervisor of meters and transformers; and **Clifford G. Johns,** automotive fleet superintendent. Two new local managers are: **Ralph Conner** at Sedro Woolley, and **Lewis Yarbrough** at Langley. **Harlan Martin** takes on new duties in the Bellingham sales department.

Maurice P. Stoelting has been promoted to labor relations manager of the Public Service Co of Indiana, and **Roland W. Eggert** succeeds him as supervisor of payroll.

Paul Welch has been transferred to the Boston headquarters of the New England Electric System.

George Rifendifer has been appointed supervisor, training and accident prevention, Duquesne Light Co.

Richard McCosh, formerly with Pacific Power & Light Co, has joined the engineering consulting firm, Ford, Bacon & Davis in Portland, Ore.

Robert A. Mitchell has been promoted to assistant district power superintendent for Pacific Power & Light Co's Willamette Valley-Coos Bay power district.

Virginia Electric & Power Co has made the following appointments: **Cecil A. Smith** to southside district manager, replacing **James V. Barker** who was recently appointed system superintendent-distribution in the system transmission and distribution department; **Lemuel L. Eley Jr** to assistant to the manager of the engineering and construction department; **Joseph D. Ristroph** to manager of power production, power department; **Eugene B. Crutchfield,** manager of power supply, power department; and **T. Justin Moore Jr,** associate general counsel.

Francis L. Rimbach has retired from his post in the agricultural department for the New England Electric System.

Byron C. Cohn, vice president and

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manager of electrical operations for Kansas Power & Light Co, has been elected to the board of directors.

A. V. Crate has been appointed executive assistant to the director of sales promotion at the Hydro-Electric Power Commission of Ontario.

Oklahoma Gas & Electric Co has named **William H. Mapes** industrial sales manager, and **Herbert R. Winters,** general office power sales engineer, replacing **Thomas E. Graham,** who has retired. Winters has been replaced as central division sales supervisor by **A. W. Weigl.**

Connecticut Light & Power Co has named **Robert P. Lee** as assistant to the vice president in charge of public and employee relations. He will continue as manager of the area development department.

Samuel F. McGowan, director of area development for Northern States Power Co, is one of a group of five business executives who are representing the US on its first trade mission to Brazil.

Harry I. Miller, vice president of division operations, Wisconsin Public Service Corp, has been named president of the Wisconsin Utilities Assn. He succeeds **Stuart V. Willson,** president, Northern States Power Co (Wis.), who became chairman of the organization's board of directors. **Martin E. Juhl,** executive vice president, Lake Superior District Power Co, is vice president; **Lester M. LaPorte,** treasurer.

George D. Pollock Jr has retired as chief electrical engineer for Arkansas-Missouri Power Co, after 35 years of service.

Georgia Power Co has named **C. Parker McRae** assistant to the executive vice president.

Erick A. Benson has been named deputy power supervisor at Grand Coulee Dam on the Columbia River in the state of Washington.

Pennsylvania Electric Co has appointed **Gene H. Huston** system superintendent of distribution, and **Daniel K. Park,** assistant to the president and manager of public relations.

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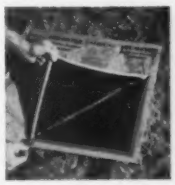
Now line crews can apply ground-line preservative treatments to poles when they do overhead work by carrying Chapman Pol-Nu Paks on service trucks as standard equipment. This convenient pole preservative bandage, available in several sizes, comes as a completely sealed envelope which is easily opened and wrapped around the pole. Chapman Pol-Nu, grease-type pentachlorophenol compound inside the bandage, protects the critical ground-line area from decay and insures longer pole life. Mail the coupon for complete information on Pol-Nu Paks and on Pol-Nu in bulk for use with the Pol-Nu Bandage-Maker when many poles are to be treated.



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3—1000 KVA G-E 34500-7200/12470Y
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3—500 KVA Penn. 13200—120/240
3—333 KVA G-E 66000—2400/4160Y
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Rapidly expanding Southwestern utility offers excellent opportunity for an equipment journeyman under age 40 to be assigned substation maintenance. Applicants should be thoroughly familiar with (6 to 8 years experience) transmission and distribution switching operations, maintenance of oil and air circuit breakers (5000—115000 Volt), substation transformers, bushings, tap changers and cooling equipment as well as auxiliary relays and batteries. Address complete resume of experience and education to: Public Service Company of New Mexico, P. O. Box 1360, Albuquerque, New Mexico. Attention: Mr. W. L. Hunt.

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The Meetings Calendar

JUNE

American Nuclear Society—Annual Meeting, Palmer House, Chicago, June 12-15.

Illuminating Engineering Society—Canadian Regional Conference, Nova Scotian Hotel, Halifax, Canada, June 13-14.

American Society of Heating Refrigerating & Air Conditioning Engineers—Annual Meeting, Vancouver, B. C., Canada, June 13-15.

Wisconsin Municipal Utilities Association—Annual Conference, Shawano, Wis., June 15-17.

Northwest Electric Light & Power Association—Accounting & Business Practice Section, Benson Hotel, Portland, June 15-17.

Internatonal Conference for High Voltage—Paris, France, June 15-25.

Oregon Rural Electric Cooperative Association—Annual Meeting, Gearhart Hotel, Gearhart, June 16-17.

American Society of Mechanical Engineers—Applied Mechanics Conference, Pennsylvania State University, University Park, June 20-22.

American Institute of Electrical Engineers—Summer General Meeting, Atlantic City, June 20-24.

1960 Conference on Standards & Electronic Measurements—National Bureau of Standards Boulder Laboratories, Boulder, Colo., June 22-24.

First Congress International Federation of Automatic Control—Moscow, USSR, June 25-July 9.

Canadian Electrical Association—Annual Convention, Manoir Richelieu, Murray Bay, Quebec, June 27-29.

National Association of Power Engineers—Annual Convention, Jack Tar Hotel, San Francisco, June 27-30.

JULY

Edison Electric Institute—Industrial Relations Committee Joint with Rocky Mountain Electrical League, Denver Hilton Hotel, July 21-22.

AUGUST

American Institute of Electrical Engineers—Pacific General Meeting, El Cortez Hotel, San Diego, Aug. 8-12.

• **Heat Transfer Conference & Exhibit**—Sponsored by ASME and AICE, Statler-Hilton Hotel, Buffalo, Aug. 15-17.

• **Summer Institute**—Principles of Nondestructive Testing, Sacramento State College, August 15-26.

• **Western Electronics Show & Convention**—Los Angeles Memorial Sports Arena, Los Angeles, Aug. 23-26.

SEPTEMBER

• **Southeastern Electric Exchange**—Personnel Administration Section, Roanoke Hotel, Roanoke, Sept. 1-2; Accounting Conference, Tides Hotel, St. Petersburg, Fla., Sept. 29-30.

• **Association of Illinois Electric Cooperatives**—Annual Meeting, St. Nicholas Hotel, Springfield, Sept. 7-9.

• **Northwest Electric Light & Power Association**—53rd Annual Meeting, Glacier Park Lodge, Glacier, Mont., Sept. 7-9.

• **Institute of Radio Engineers**—Joint Automatic Control Conference, Massachusetts Institute of Technology, Cambridge, Sept. 7-9.

• **Rocky Mountain Electrical League**—Annual Fall Conference, Hilton Hotel, Denver, Colo., Sept. 7-10.

• **American Society of Mechanical Engineers**—International Air Pollution Congress, Statler-Hilton Hotel, New York City, Sept. 10-11.

• **Electrical Living Show**—New York Coliseum, New York City, Sept. 10-18.

• **Illuminating Engineering Society**—1960 National Technical Conference, Penn Sheraton Hotel, Pittsburgh, Sept. 11-16.

• **Northwest Public Power Association**—Accounting Section, Annual Meeting, Wenatchee, Wash., Sept. 14-15; Power Use Section, Annual Meeting, Hotel Monticello, Longview, Wash., Sept. 29-30.

• Additions this week.

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Chance EPOXIGLAS® Hot Sticks

Thorough tests in the Weather-Ometer show that Epoxiglas is moisture-proof. Sticks exposed to extensive sunlight and 100% humidity show no deterioration or moisture absorption.

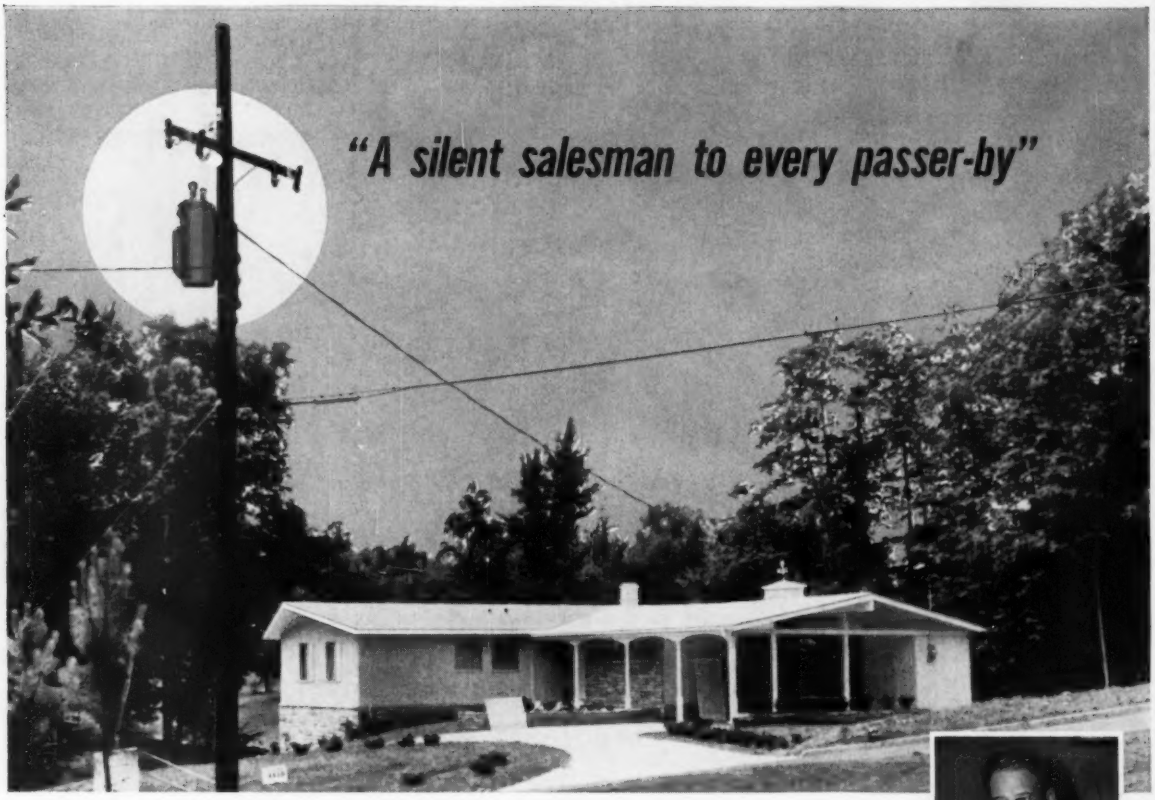
Proved Totally Moisture-Proof

Your linemen are safer, between tests, with Chance Epoxiglas Hot Line Tools because these tools have been thoroughly test-proved in the field and here in the lab to be moisture-proof, and consistently stronger than wood. Moisture can't penetrate the tough, almost indestructible Epoxiglas exterior, and a unicellular, plastic foam core prevents interior moisture condensation. All Chance hand tools, wire tongs, and link sticks are now available with Epoxiglas handles. You get tools that have extremely low electrical leakage . . . greater flexing strength . . . greater tensile strength than wood sticks. Get the whole Epoxiglas story from your Chance Man . . . then give the man on the pole a CHANCE for safety.

A. B. CHANCE COMPANY
CENTRALIA, MISSOURI
(A. B. Chance Company of Canada, Ltd., Toronto)

ABC INDUSTRIES

CT60-21



J. B. FOUNTAIN, OF MISSISSIPPI POWER AND LIGHT COMPANY REPORTS:

"Gold Transformers on Total Electric Homes Help Open the Door to More Sales"

Shown above is an all-electric model home served by Mississippi Power and Light Company and equipped with a Kuhlman Gold Transformer. During open-house ceremonies, MP&L uncovered 52 qualified prospects from among the 442 registered visitors.

"The attractive Gold transformer quickly identifies an all-electric Gold Medallion home and serves as an effective silent salesman to everyone who passes by," says Mr. Fountain, vice president of this progressive utility.

Only Kuhlman has the Gold transformer *and* the Gold merchandising kit to help you start your own program. Contact your Kuhlman representative today for the complete promotion package which contains all the sales aids you need to launch the Gold transformer program in your area. The kit is free—just call your local Kuhlman representative. Do it right away!

KUHLMAN TRANSFORMERS

KUHLMAN ELECTRIC COMPANY, Birmingham, Michigan

Manufacturers of transformers since 1894

FACTORIES: Bay City, Mich. • Crystal Springs, Miss. • Salinas, Calif.

LOOK FOR THE GOLD TRANSFORMER, SIGN OF ELECTRICALLY HEATED HOMES